DEPARTMENT OF DEFENSE

PANEL TO REVIEW THE V-22 PROGRAM

FINAL DELIBERATIONS

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P R O C E E D I N G S

LIEUTENANT COLONEL LAPAN: Good morning, ladies and gentlemen. I'm Marine Corps Lieutenant Colonel Dave Lapan. I work in Public Affairs for the Office of Secretary of Defense. This is the second and final open meeting of the Panel to Review the V-22 Program.

Now, the purpose of today's session is for the Panel and its staff to conduct deliberations in advance of submitting its final report to the Secretary of Defense. The Panel will not take questions or comments from members of the audience. Public input was the purpose of the first meeting. If you have any questions, please direct them either to me or to the Panel's executive secretary, Mr. Gary Gray.

The Panel is composed of four members: retired Marine Corps General John R. Dailey, who is the Panel chairman; retired Air Force General J.B. Davis; Mr. Norman R. Augustine, and Dr. Eugene E. Covert.

The Panel has a staff of four: Mr. Gary Gray, who I mentioned, is the executive secretary; Colonel Rick Schwartz, who is the representative of the Marine Corps; Colonel Andy Steel, representing the U.S.

Air Force; and Mr. Bryan O'Connor, who is the technical consultant for the Panel.

Members of the media that would like to take photos of the Panel members or staff should first coordinate with either Dr. Hector Nevarez, who is standing here in the front, or me, so as not to disrupt the meeting.

Thank you for your cooperation, and thank you for being here today.

General Dailey, sir.

GENERAL DAILEY: Okay. Thank you, Dave.

Could I have the first slide.

For the benefit of the press, and also those of you who are in attendance today, I'd like to review the activities of the Panel to get us to this point. We started with the commissioning of the Panel on the 15th of December, a pre-brief with the Deputy Secretary of Defense on the 28th of December, and then began our fact-finding activities on the 11th of January.

This consisted of getting briefings from the Marine Corps in terms of the requirement and the ability of the aircraft to meet the requirement from the Program Manager and the status of the program as he saw

it. We talked to GAO. We talked to the test folks, and we talked to NAVAIR. We then developed a set of issues that we had developed throughout the entire process, but the next phase was to go through the mishap briefings and to continue our data-gathering.

We then, in March, spent a week on the road with visits to the training squadron at New River, the Special Operations Command, where we got a revalidation of the requirement as they saw it, and then to Bell Helicopter in Fort Worth and Amarillo, and then up to Boeing Helicopter in Philadelphia.

On the 9th of March, we conducted an open meeting to give anyone who had an opinion that they wanted to present to the Panel the opportunity to do so. We then went back into fact-finding.

And one of the things that I should stress here is that at each stage, and actually continuously throughout this time frame the staff continued researching the issues. We would come up with an issue and then they would do the research necessary to determine the facts associated with that particular issue, and so it's been a very busy time for the staff particularly, and the Panel.

Then we broke into subpanels based on the number of issues we had and the subjects, and we have been working at the subpanel level now for the last month, to where we have developed the issues with a discussion, a conclusion, and recommendation(s). And our purpose today is to discuss the conclusions and recommendations to ensure that all members of the Panel agree with them as stated.

We are now at today's meeting, which is our final open meeting before we make our presentation to the Secretary of Defense on the 24th, but the information that we review here today will constitute the report that we present to the Secretary.

We will then work to get the final report published and on the Web by the 30th of April. And we have congressional hearings on the 1st of May with the Senate Armed Services Committee and the House Armed Services Committee where we will use this same information.

So today is where we bring it all together as a Panel. As I mentioned, we've been working at the subpanel level up until this time.

So we're ready to proceed now.

And, Bryan, are you ready to...

MR. O'CONNOR: Good morning, gentlemen. I have four issues I'm going to bring forward. Again, these are potential conclusions/recommendations that have come out of the subpanels. The first one is in the safety area.

In fact, we're going to cover these in the order of safety first, and then combat effectiveness. And I will talk right now about crashworthy fuel cells, flight control system reliability, what we learned from the Vortex Ring State issue, and crew qualifications for OPEVAL, before I'll hand it over to Colonel Schwartz, who will take it from there. And then you'll see us getting up and down, presenting as we go along in the areas of safety. And on the next slide, you'll see there are several issues on combat effectiveness, and then programmatics, and then at the end we'll have summary recommendations and discussions.

The first safety issue is one that came up a couple of times in our reviews, and that was crashworthy fuel cells. The issue here is that we have three types of fuel cells out there. The first one, in the first couple of LRIP lots -- that's aircraft 1

through 11 in LRIP -- in the Low Rate Initial Production aircraft, were extensible fuel cells, a special design that fills the containment of the sponsons.

The second group went into lots 3 and 4. Although that original fuel cell had passed its drop test, it was not in a sponson, so it was not a complete test. The redesign gets rid of the extensible fuel cells, puts them in the sponson. The test for that set of fuel cells failed. Those fuel cells started leaking when they were dropped the 65-foot drop test.

So the third redesign is effective from aircraft 30 and beyond, the very last aircraft of lot 4 and beyond.

And the real issue here is that in order to justify continuing to fly with those earlier fuel cells that were partially tested or that actually failed the drop test, risk assessment was done by the Program to justify that. The Program did recommend to proceed in that way. And the training squadron told us on visit that they did not understand the rationale for keeping those non-compliant fuel cells, and so it's a communications problem on top of the technical issue.

DR. COVERT: Bryan, excuse me. It might

be helpful for me and for others to define what the risk assessment is for category 1D. In other words, what's the probability of --

MR. O'CONNOR: Okay. The way the Program categorizes risks, the "1," "2," "3" means how critical the potential effect might be. "1" is the worst -- that is, loss of life or aircraft. "2" would mean major damage.

When you see the "A," "B," "C", "D," you're now talking about the probability that this could ever result in that effect. The "D" is, of course, the fourth one down, which means it's a remote probability. And the way the Program does that is if there's any way that anybody can consider that something like this could happen in the life of the program, which would be several million flight hours, then it goes into the "D" box.

So this is one where it could cause loss of life or crew in the life of the program.

DR. COVERT: Thank you.

MR. O'CONNOR: The potential conclusions. There were two. One, fuel sponson upgrade planned for aircraft 30 and subsequent will meet the requirement for crashworthy fuel cells.

And although the program risk assessment satisfied the Program Manager that the non-compliant fuel cells are safe for flight, the concerns expressed by the training squadron should be addressed.

Recommendations that come from that: The program should plan to retrofit all operational aircraft with crashworthy fuel cells -- that is, compliant fuel cells -- at the first opportunity. The first two lots of aircraft extensible fuel cells should either be tested in a sponson against the crashworthy requirement or they should be replaced by compliant non-extensible fuel cells. And the third and fourth lot aircraft should be retrofitted with compliant fuel cells. In the meantime, the communications are the rationale for this risk acceptance should be passed on to the operators who will be flying these aircraft.

Do I have any questions on this issue?

MR. AUGUSTINE: I guess, Bryan, that we should probably just note that this all presumes one were to proceed with the program, or else it's irrelevant.

MR. O'CONNOR: That's exactly right.

MR. AUGUSTINE: But if one were to proceed, certainly this would be the minimum sort of

thing one would want to do in this area.

MR. O'CONNOR: In fact, I may want to say right up front that all of the conclusions and recommendations that have anything to do with what the Program might do to correct a deficiency would be in that same light: that should the program go forward, they should fix this or they should spend money on that, whatever.

Now, the next issue is Flight Control System Reliability.

GENERAL DAILEY: As a matter of fact, it would be that it should not go forward without fixing it; is that also -- could that be said?

MR. O'CONNOR: It could. Yes, sir.

GENERAL DAILEY: So we have a -- There's a fix that --

MR. O'CONNOR: Right.

GENERAL DAILEY: -- which will be incorporated in aircraft No. 30 --

MR. O'CONNOR: That's correct.

GENERAL DAILEY: -- which will then meet the requirements. Okay. And all subsequent aircraft.

MR. O'CONNOR: Right.

GENERAL DAILEY: Okay. In other words --

MR. O'CONNOR: We'll make that change, then.

GENERAL DAILEY: And then there has been an assessment made that the need to retrofit 1 through 29 is not necessary? Is that what we're saying here?

MR. O'CONNOR: That's correct.

GENERAL DAILEY: Okay. And then that information -- we're recommending that that rationale be made clear to the operators of the aircraft as to why the decision was made?

MR. O'CONNOR: That's right.

GENERAL DAILEY: Okay.

GENERAL DAVIS: Bryan, had these had all compliant fuel cells, would that have prevented any loss of life in the accidents that we have seen?

MR. O'CONNOR: No, sir. The 65-foot drop test is nowhere close to the kinds of forces that we've had in a couple of the mishaps. So we're not talking about something that may have saved lives in one of the mishaps here. We're talking about hard landing from an autorotative descent or something like that where these could rupture.

The next issue is Flight Control System Reliability. The flight control system originally was required and designed to a specification of an overall reliability goal of one times ten to the minus seven. That is one catastrophic loss in 10 million flying hours. This is about the same as the C-17 was designed to. It's a couple of orders of magnitude better reliability than the F-18 fighter was designed to, and it's not as good as the reliability that the Boeing 777 is. So it's in between a 777 and a fighter as far as reliability overall requirement.

The way that the designer tries to meet a number like this is twofold. One, high reliability components, and the second way is by redundancy. To meet that kind of a requirement, this aircraft had to be built with triple redundancy, and so it's that combination of high reliability parts and triple redundancy that is the key to this design.

There are in this aircraft, just as there are in all aircraft we looked at in our analysis, quite a few single point failures in the system. Those single point failures -- And what I mean by "single point failures" is a single failure can cause catastrophic

loss.

In any machine like this, you will have a list. This one was no bigger or smaller than you would expect. And that list, by requirement and by a Naval Air Systems Command policy, is that those single point failures require special attention, both in material selection; special inspections, both in production and through the life of the equipment and operations; lifetime tracking; and special treatment and maintenance plans. For example, special access or inspections or whatever.

However, what we did find was that there are no special treatments required for the next level of those three levels of redundancy; only that first one gets special treatment. But we found that there is no special treatment for the other exceptions to the Fail Operational/Fail Safe design requirement.

And the reason we looked at this, of course, is because that's the part that was in the North Carolina mishap -- was one of those. It was one of those lines that is what we would call "Fail Safe," because a single line took out two levels of redundancy. This is not unique to the V-22, that this special emphasis is not

applied to those types of parts. It's across the board.

Now, we didn't look through all DoD, but that's why we mentioned Naval Air Systems Command here.

And, of course, the other aspects of this are that the operational environmental effects are worse than predicted, so that other features of a good reliability design -- that is, high reliability components -- we notice that a lot of components, especially in the flight control system hydraulics, are not working in the field to the reliability that we had hoped and predicted early on -- "we," meaning the program.

Now, the final point here is that there is a Tiger Team looking at all aspects of the hydraulic design and the support of the hydraulic components in the system.

That's the hardware part of this story. The next slide shows the software.

Prior to the North Carolina mishap, the integrated hardware/software testing that was conducted at Boeing, where this analysis is done, was judged by all to be adequate. The integrated software/flight control system anomaly that was a factor in the mishap was not

foreseen. Although the hydraulic -- the hardware part of it -- was an issue that had been addressed, the software was not. That was a surprise.

The findings of the mishap investigation have resulted in upgrades to what was considered before to be adequate. Now, in retrospect, the whole program realizes that they need to have a better way of flushing out potential risks in the integrated software flight control system, and they have already taken actions to get man-in-the-loop into their simulation and to do more integrated testing and to include all the emergency procedures and failure cases as they go forward.

Now, if the program goes forward, all of those things would be required, probably before the next flight.

There is also a "Graybeard" assessment -- what they call a "Graybeard" assessment going on, a look at the whole process of how software and integrated flight control system is developed and tested.

Conclusions that came from the subpanel on this particular set. Again, I'm dividing it into hardware and software.

V-22 flight control hydraulic components

are experiencing failures at higher rates than predicted. Flight safety is therefore highly dependent upon the redundancy features in the system.

Inaccurate predictions of component reliability affect spares planning, operational suitability, squadron staffing, and flight safety.

NAVAIR policy currently requires that special attention -- that is, materials, tolerances, quality inspections, tracking, et cetera -- be applied to all single point failure modes in the flight control system, but does not require any special attention be given to other exceptions to the flight control redundancy design criterion. And again, the mishap hydraulic line is an example.

On the software side, the North Carolina mishap identified limitations in the V-22 Program's flight control software development and testing. The complexity of the V-22 flight control system demands a thorough software risk analysis capability during development. The complexity of the V-22 flight control system demands a highly integrated software/hardware/man-in-the-loop test capability.

If there are no questions about the

conclusions, I'll go to the recommendations that come from those.

DR. COVERT: Bryan, I think it's fair to point out that inaccurate predictions of component reliability is not uncommon in any system --

MR. O'CONNOR: Yes, sir. We --

DR. COVERT: -- commercial or otherwise.

MR. O'CONNOR: Right. We found that also.

Potential recommendations, then.

On the hardware side, we recommend that -- Now, a lot of times I'm not going to say who we think should do these. We have steered clear of that. So in many cases we'll just give the recommendation, and you'll see that throughout all these presentations.

Improve life cycle handling -- that is, design, material selection, tracking, inspections, et cetera -- for all exceptions to the Fail Operational/Fair Safe flight control system design requirement; continue to improve the hydraulic system component reliability; take appropriate steps to mitigate the risk of loss of hydraulic system integrity -- that is, especially chafing, which is one of the biggest issues there; fittings; leaks and vibration.

Develop techniques, tools and methods for timely identification of hydraulic line chafing; assess the process used by V-22 contractors to predict component reliability numbers, and take steps to improve.

And again, sir, you may want to broaden that beyond V-22.

DR. COVERT: I would think it would be in order --

MR. O'CONNOR: Okay. We can do that.

DR. COVERT: -- to broaden it. Not only to V-22, but all future aircraft or flight systems.

MR. O'CONNOR: All right. Develop appropriate controls -- that is, design and life cycle support -- for all exceptions to flight control system redundancy requirements, not just the single point failures.

On the software side, the V-22 Program should conduct a comprehensive flight control software risk assessment prior to return to flight; conduct an independent flight control software development process review of the V-22 Program with an emphasis on integrated system safety. This means beyond the planned Graybeard. They ought to look at their Graybeard process and make

sure it's truly independent and they've got the world's experts helping out here.

The Program should not return to flight until the flight procedure and flight control software test cases have been reviewed for adequacy, and evaluated in the integrated test facilities.

MR. AUGUSTINE: Bryan, the take-away I get from this -- and you can test me -- is that the specifications are adequate; the implementation of the hardware, particularly with regards to the hydraulic system, is clearly inadequate in its current form.

MR. O'CONNOR: That's correct.

MR. AUGUSTINE: And that the software really wasn't adequately tested in off-nominal modes, and that needs to be done. Is that --

MR. O'CONNOR: That's correct.

GENERAL DAVIS: Now, Mr. Chairman, the last one in "software" I whole-heartedly recommend. That ought to be complete before the wheels leave the ground.

GENERAL DAILEY: As we proceed through these, we'll assume that it's accepted by the Panel as modified by comments.

MR. O'CONNOR: As modified by comments.

And if you think one of these ought to go away altogether or we ought to add one that we haven't discussed, we'll do that here as well. There are a couple of cases later on where we have some either/or's, and we're going to need some help on selecting which one.

GENERAL DAILEY: On the last, this verification in the integrated test facilities, are we comfortable that they have an adequate facility to accomplish this?

DR. COVERT: Yes, sir. I visited it and looked into it very closely and I believe they are well on their way to being able to integrate not only the simulator and the man-in-the-loop, but the real hardware in the hydraulic system. And as Bryan noted, not only the real hardware, but with the loads on the hardware in the simulated flight.

So I think it's about as close as you can come to the real thing without flying it.

GENERAL DAILEY: Okay. So we have confidence in the approach that they're taking, then. Or is it they're proposing to -- Is this actually under way?

DR. COVERT: This is under way, sir.

GENERAL DAILEY: Okay. All right.

MR. O'CONNOR: They began taking quite a few actions in those two areas as soon as the mishap investigation findings began to come out.

MR. AUGUSTINE: I think in that regard one has to couple the testing you referred to being done at Bell/Boeing in the lab with the hardware in the loop, which will verify that the system as designed in a laboratory environment will work effectively.

Then there's the other piece of it which says that when you wrap all this up inside of a nacelle and in a cockpit, are there environmental circumstances that may cause a sound design in the lab not to work?

MR. O'CONNOR: Right.

MR. AUGUSTINE: That's the other half of it.

MR. O'CONNOR: Well, you know, that point gets back to the other one about predicting reliability ahead of time.

MR. AUGUSTINE: Exactly.

MR. O'CONNOR: The models that are used to predict reliability may not have enough emphasis on real-world operational environments.

DR. COVERT: In other cases, it's been

important under these circumstances to actually measure the environment in the nacelle: the vibration loads --

MR. O'CONNOR: Right.

DR. COVERT: -- the acoustic loads, and the temperature. That's not included, as you pointed out, Norm, here.

MR. AUGUSTINE: Right. Yeah, the problem is that the models -- as useful as they are, they don't include adequately things like "does a clip rub on a hydraulic line?"

MR. O'CONNOR: Right.

MR. AUGUSTINE: It's designed not to.

GENERAL DAILEY: Well, the professor has mentioned some measurements in the -- Have those already been done?

DR. COVERT: It's my understanding that they are instrumented in nacelles.

GENERAL DAILEY: Okay.

DR. COVERT: And I won't go so far as to say they have been done, but they're aware of this issue.

GENERAL DAILEY: Okay.

MR. O'CONNOR: We'll go on to the next one, then.

GENERAL DAILEY: Well, do we need to add a comment to -- "if it has not been, that --"

GENERAL DAVIS: I think that's --

MR. O'CONNOR: Okay. We'll add that --

GENERAL DAILEY: All right.

MR. O'CONNOR: We'll add that recommendation.

The next one: Mirana Mishap, Vortex Ring State.

GENERAL DAVIS: Let's go back, Bryan. Where are we going to add that? I guess that's probably as important as adding it. Are you going to add it under "hardware," or under "The Program should not return to flight until the flight procedure and flight control software test cases have been reviewed for adequacy, and evaluated in the integrated test facilities"?

MR. O'CONNOR: You know, we have another discussion coming up on reliability, maintainability, and the nacelle.

GENERAL DAVIS: Okay.

MR. O'CONNOR: And maybe that's the right place to put it, because this whole concept of reliability we found throughout the visits and the

subpanel reviews has about three different aspects to it. One is flight safety aspects to reliability: pieces failing. The second one is the maintainability part of it, and then nacelle. And the third is spare parts, and so on. It's almost -- It's a problem that has effects throughout.

So if you can --

GENERAL DAVIS: Well, the reason I ask, I kind of think -- my initial feeling would be to add it in this area because -- the flight control system reliability --

MR. O'CONNOR: Okay.

GENERAL DAVIS: -- because of those things, but I'll reserve comment until --

MR. O'CONNOR: Well, we'll put it as a placeholder in here that -- And again, the recommendation is that the nacelle be instrumented.

Is that right?

DR. COVERT: If it's not already.

MR. O'CONNOR: Yes. And we think it is already, but just to make sure.

DR. COVERT: I think it is.

MR. O'CONNOR: So that they can get good

data on it.

Next. This one, the issue was the Mirana mishap and Vortex Ring State discussion.

Now, of course, we didn't go do an independent investigation of the mishap. It was out of our charter. But what we did do is look at the results that came from the investigation, the JAG investigation.

The primary cause: Vortex Ring State or Power Settling; contributing cause: poor formation flight coordination -- key factors from the investigation and top level analysis that was done as part of our work.

The lead aircraft continued a steep tailwind descent despite an 800-foot-per-minute/40-knot-calibrated-airspeed warning in the NATOPS. The night formation flight coordination was poor. The conversion timing and the deceleration was unsynchronized. We noticed big differences in time between lead aircraft converting nacelles and the second one, which is where that one came from.

NAVAIR developmental testing was limited to that required to clear 800-foot-per-minute and 40 knots. They didn't do further testing to go down and really look at the components of VRS in this program

before this mishap.

V-22 is vulnerable to VRS.

Now, this was forecast by the engineering community. How well it was communicated to the operators -- don't know. That's a tough one. But it was forecast by the engineering community. The part of VRS that was unique to the V-22, the role excursion due to asymmetric VRS on one side versus the other, was not well forecast, if at all, by the engineering community.

NATOPS coverage of VRS was limited and misleading.

Now, since then, they've put a new NATOPS coverage of VRS in four different sections in the NATOPS. It's got what we consider appropriate coverage for that type of topic in there now, but it certainly wasn't before the mishap.

NATOPS discussion of formation approaches lacks any discussion of inter-aircraft coordination. We think that's going to be important.

Potential Conclusions.

The first conclusion from looking at the mishap investigation results was performance of the mishap crews was inconsistent with the risk of VRS to the

V-22. Although the current 800-foot-per-minute/80-degree nacelle flight limitation may offer adequate safety margins, the envelope, the warning signs and flight characteristics of V-22 VRS are still not well defined.

Night formation flight approaches require inter-aircraft coordination, especially during early nacelle conversion, and if future operating limitations following completion of flight test envelope definition were to include another reference to 40 knots, then the V-22 airspeed indication system may not be adequate as it is unreliable below 40 knots.

Recommendations.

First, use the results of planned high rate of descent flight tests to update/develop operating limitations, procedures, pilot training, and, if appropriate, a cockpit warning system; configure the simulator that the pilots train in with the capability to provide VRS avoidance training; if testing indicates poor aerodynamic warning -- and initial indications are that it isn't very good -- then the aircraft should be configured with a cockpit warning system.

And I've got the three things that came up here. You can see that are potential things that could

feed a cockpit warning sign or system: airspeed/sink rate combination; proprotor instrumentation or aerodynamic precursors.

If flight tests indicate the need for an airspeed envelope flight limitation of 40 knots or less, the Program should procure or develop a more accurate airspeed indicator. And finally, the NATOPS Model Manager should develop procedures for inter-aircraft coordination during formation decelerating conversions.

Any discussion on these conclusions and recommendations?

MR. AUGUSTINE: Yes. I would just comment that -- to try to summarize what I thought we've learned on this topic, at the risk of oversimplifying -- is that in this case, the aircraft was clearly out of the flight envelope; that the NATOPS manuals to tell the pilot where the flight envelope was were poor. They were inadequate.

MR. O'CONNOR: Right.

MR. AUGUSTINE: That the consequences of VRS, although not unusual to anything with rotary wing, are more severe for the V-22 because of the side-by-side rotor configuration.

And lastly, that if one is to proceed,

it's essential to define what is the envelope -- the prohibited envelope, and the presumption is that that envelope is small enough that the aircraft is still useful in an operational role --

MR. O'CONNOR: Right.

MR. AUGUSTINE: -- which is what the test pilots all seem to believe.

Is that a fair --

MR. O'CONNOR: Yes, sir. And we're going to touch on a couple of those a little later, too, when we talk about tiltrotor unique safety issues; but those are all consistent.

GENERAL DAVIS: Bryan, I've been working with you on this thing and I, as a pilot, feel very strongly that you ought to give that aircrew member, regardless of the amount of stress or non-stress that he has, every opportunity -- he or she, every opportunity to be aware of things that are going on that might cause you to get in a very difficult position.

And from that aspect, I am absolutely convinced that a cockpit warning system of some design needs to be placed to provide additional situational awareness for those aircrew members.

MR. O'CONNOR: Okay. Now, there's --

GENERAL DAVIS: So I object to "if appropriate," if that's the one that we select.

MR. O'CONNOR: All right. There's one where we have a caveat on there, and your suggestion is, "Let's don't put the caveats. Let's just recommend as a Panel that a cockpit warning system be installed."

GENERAL DAVIS: Absolutely.

MR. O'CONNOR: Okay.

GENERAL DAILEY: Okay. Any other comments on this one? Okay.

MR. O'CONNOR: Next is OPEVAL Crew Qualifications Discussion.

One of the things that we -- We didn't try to just look at what's coming out of the Program Office or whatever. We tried to ensure that we looked at all issues, perceptions, things that are in the press and so on, to try to find out if there are issues there. One of those that came out in this fashion was press accounts and OPEVAL mishap family concerns that we heard in our open meeting: that operational pilots may have been improperly placed into a test environment.

Now, this, of course, comes out of the VRS

mishap that happened during OPEVAL. So what we did was take a look at the process, the policies and so on. OPEVAL and Developmental Test have different requirements for aircrew. The Development Test pilots are required to be either engineering or experimental test pilots. OPEVAL test requires highly qualified aircrew, not engineering and experimental test pilots, but operational crews with recent operational experience with a lot of experience and qualifications.

Now, the records show that there was a rigorous selection process. The six pilots that were selected for OPEVAL crews were out of 120 applicants, so they had a pretty rigid process. The squadron HMX-1 has a training syllabus that was reviewed by our Panel and the flight assignment process and procedures were reviewed and they were -- they're both complete and were apparently complied with during this OPEVAL.

Policy does prohibit OPEVAL pilots from participating in developmental test flights without special designation. There was one exception during DT, but our assessment shows that that one was formally accepted by both sides of the chain of command and it was based on an analysis that the risk for that particular

flight was low.

Part of the public perception problem with this one may be a concern that goes directly to what happened in the mishap. We actually -- The system learned a developmental test kind of lesson during an operational test, and that's the heartbreak of that one.

Potential Conclusions.

The process for crew selection, training and assignment to V-22 OPEVAL test flights was reasonable and consistent with longstanding policy. By its nature, early OPEVAL flights are characterized by a level of risk that's higher than that of fleet operations -- that's why they pick experienced crews -- but less than that for development test phase.

Recommendations.

As the testing program proceeds, test managers -- that's contractor, NAVAIR, and operational -- should continue to pay special attention to selection and assignment of flight crew members, regardless of what phase they're in: development test, operational test, or operations. Based on experience so far, it appears prudent that as NAVAIR continues to develop and test the V-22, they should take all reasonable steps to ensure

that OPEVAL aircrews are not subjected to undue risk by thoroughly assessing all known and suspected high risk flight regimes.

DR. COVERT: Bryan, I have a suggestion here that may be out of order, and if it is -- and you're going to talk about it later -- please correct me.

I think that in many OPEVAL operations it's necessary to have the airplane loaded up with the design weight for the particular mission that they're evaluating. It's not obvious to me that under a number of circumstances the test won't proceed as well with sandbags in the seat as they would with people, and I would suggest that perhaps this is a place to make a recommendation that you limit the use of people in these tests to those situations where it's absolutely essential.

Is this out of order for this point?

MR. O'CONNOR: No, sir. I mean, if you'd like to --

GENERAL DAILEY: Well, actually, passengers is what you're talking about as far as --

DR. COVERT: That's right.

MR. O'CONNOR: So the recommendation,

then, would be that flights during any test operation should be limited to only those necessary for the test objective, and that would cause people to question: "To do this test objective, do we have to have a human being, or can we do it with a sandbag?"

DR. COVERT: That's right, because you have to --

MR. O'CONNOR: We can add that recommendation.

DR. COVERT: Okay. We have to fly the airplane with the heavy loads and --

MR. O'CONNOR: Right.

DR. COVERT: -- all the sluggishness that goes with it, but -- Anyway, thank you.

MR. O'CONNOR: Okay.

MR. AUGUSTINE: Another question arises: why in DT -- Development Test -- the problem wasn't found. Actually, the problem was known. Really, the boundaries weren't known. And it would seem that development -- We clearly should have found it in operational testing.

MR. O'CONNOR: Are you talking about the VRS now?

MR. AUGUSTINE: Yes.

MR. O'CONNOR: There was an extensive set of tests under the label of Power Settling. That label, when we looked at it -- We asked NAVAIR, because a whole bunch of those tests had nothing to do with Power Settling -- they were higher speed -- and they admitted that that was a mis-labeled test.

But the subset of those tests that did have to do with Power Settling investigation -- a smaller number of tests -- was fundamentally cut in half because of the analysis that said, "You don't have to do each of these tests twice. Once at a high" -- or at an aft CG and one at a forward CG. The analysis said that CG has nothing to do with VRS. So that cut it down to smaller value.

MR. AUGUSTINE: Yes, I remember --

MR. O'CONNOR: And then what they decided was that the testing for VRS in this aircraft required prior to operational evaluation, was that testing that was needed to ensure that the 800-and-40 limit -- which was as a warning in the NATOPS, but make sure that that 800-and-40 was safe, not to go down and investigate the nature of VRS. That part was deferred until later. As

far as they were concerned, they needed to have a cleared flight envelope for operational evaluation and that's what was tested. So it was a limited number of points.

Now, it did go beyond 800-and-40. I think there were several points that were higher than that, but they never did actually experience VRS in Development Test prior to the mishap.

MR. AUGUSTINE: Yes, I do remember that discussion.

GENERAL DAILEY: But what you're saying is that they did test up to the level that the aircraft was cleared for the OPEVAL. So they --

MR. O'CONNOR: Yes, sir. They cleared 800 and 40, and that was the --

GENERAL DAILEY: And it was tested to that limit before. And then that was what the published envelope was for the test?

MR. O'CONNOR: Well, now, that's where we get into another discussion. If you consider that the NATOPS book flight limitations is where the published limits are, or the message that comes out of NAVAIR that says this is the flight clearance, 800 and 40 was in neither one of those. The 800-and-40 was only mentioned

one time in any of the paperwork, and that was as a warning under something called "Settling with Power."

So it was misapplied in the NATOPS book --

GENERAL DAILEY: Misapplied or misplaced?

MR. O'CONNOR: It was misplaced.

Now, it was a warning and pilots should not go there, that's true, but it was misleading.

DR. COVERT: You would suspect that would be under "flight characteristics" or something.

MR. O'CONNOR: Well, we looked at all the helicopter NATOPS books. It's more or less covered differently in every one of them. In some of them, there are no emergency procedures. It's in the flight characteristics and so on. Each one tends to be a little different. Some of them have no numbers in there. In fact, in H-46 and H-53, there is no mention of 800 and 40, but you go to the Hueys and you see that number in there.

So each one's a little different, but this one was probably -- I would guess -- I'm not going to guess. This one was inappropriately -- it was misleading, how it was in there.

However, NAVAIR did acknowledge the number

and included that thinking in their test plan, and they only tested until they were satisfied that 800 and 40 was okay, and that's all the testing they did.

MR. AUGUSTINE: How does a pilot of a UH-46 know where the limits are if it's not in the NATOPS manual?

MR. O'CONNOR: I'd have to defer to an H-46 pilot, sir.

COLONEL SCHWARTZ: The 800 and 40 is some of our initial training that we get as helicopter pilots. That's grounded in helicopter pilots from initial flight training on, so that's pretty much the basic parameter that we are taught.

MR. AUGUSTINE: Shouldn't it be in the NATOPS manual? Isn't that kind of the bible for the --

COLONEL SCHWARTZ: Yes, sir.

MR. AUGUSTINE: It seems like that might be something we ought to be --

MR. O'CONNOR: Well, it's more generally discussed in the H-46 and the H-53 book. More like, you know, when you get to high sink rates and low speeds, you can experience Power Settling, and they talk about it but they don't necessarily put a number on it.

MR. AUGUSTINE: Well, if there is a clear limit -- and it seems like there should be -- it would seem like all flight manuals ought to include that for all aircraft. It seems like that's something we ought to --

MR. O'CONNOR: Well, we can put that as a consideration as well, then: recommend that all aircraft that do not have an airspeed sink rate limit consider the addition of such a thing, because VRS is bad news for any helicopter, not just V-22.

MR. AUGUSTINE: Yes. I'm not a pilot, but I was thinking more of the case where you know there's a problem and I guess you can teach people to stay out of that area, but it also seems that it ought to appear in the manual --

MR. O'CONNOR: Right.

MR. AUGUSTINE: -- rather explicitly.

We ought to consider that as a --

MR. O'CONNOR: Okay. If that's it for that one, Colonel Rick Schwartz will now take you through pilot training and some of the other issues.

COLONEL SCHWARTZ: Gentlemen, I'm going to be talking to you about three subpanel issues: aircrew

training, downwash concerns, and autorotation. Regarding aircrew training, as part of the Panel's charter you were tasked with addressing training specifically as a factor as it affects safety and combat readiness.

Now, in order to do that, what the subpanel did was first take a hard look at the Training and Readiness manual, which is the bible for aircrew training. It provides a template for standard MV-22 units. It provides the basic program instructions for all the syllabuses, and it defines the squadron core capabilities and the basic aircrew qualifications and the requirements to maintain core skills for pilots.

What we did then was look at the progressive approach to training, looking at the ground training that the pilots get and aircrew get prior to flight. We looked at the Integrated Multi-media Instruction that is for both pilots and maintainers, crew chiefs, and we looked at the simulators.

We found that the IMI was a quantum leap over current U.S. Marine Corps ground training tools available. The full flight simulator, which some of you gentlemen had an opportunity to fly, was state-of-the-art.

Fully networkable was one of the benefits, and they have done that down at New River with the other flight simulators that are down there. It's also fully networkable with Flight Training Devices. These are not motion-based simulators, but other simulators that the squadron's going to get. They're going to get -- VMMT-204 is going to get four VSSs and three Flight Training Devices.

We then looked at the NATOPS manual, the Squadron Standardization Manual used by VMMT-204, the manual that they use to standardize their procedures within the squadron. We looked at the NATOPS -- Naval Aviation Training and Operating Procedures Standardization Manual -- and we looked at the Tactics Manuals. All of these are undergoing modifications and updates. That is normal for this stage in aircraft fielding. The last NATOPS change had over a thousand changes, and that's due to be published on 1 May.

Although money has been programmed for upgrades to both the IMI and the simulators, DoD funding in this area has traditionally suffered, and that's one of the concerns that the subpanel wanted to bring up.

DR. COVERT: Rick, does that imply that if

you're not careful, you're going to end up with simulators that don't represent the current condition of an airplane and how to maintain it?

COLONEL SCHWARTZ: Yes, sir. And that's always been a traditional weakness within our training -- our inability to keep up with the changes. We try to get them -- We want to get them to the fleet units, the tactical units first. Sometimes we're not aggressive enough in getting them into the simulators where the training needs to take place, so that was an issue that the subpanel wanted to discuss.

DR. COVERT: So if you don't keep them up, then you actually -- people train and have to be untrained again when they go to the airplane.

COLONEL SCHWARTZ: Well, the procedures might have changed, sir, and some of the equipment within the aircraft might have changed. There may have been new radios inserted in the aircraft and they're not put in the simulator, or other pieces of equipment that might have changed.

GENERAL DAILEY: We've seen some evidence that this program has been underfunded because of actions that have been taken in various ways. Is this an area

where that might be the case or that you're concerned that it would be because of funding? You're talking about funding being the issue here -- right? -- not a lack of priority or attention to detail or that sort of thing.

COLONEL SCHWARTZ: Yes, sir. This area right now is fully funded. There is a very healthy program in place to get flight simulators to 204 and to get the IMI to where it needs to be. The problem is, again -- Going forward, this is an area of concern. So looking at future requirements, this is something that we want to make sure that the Department of Defense is aware of has always been a problem and that this does get adequate attention --

GENERAL DAILEY: Okay.

COLONEL SCHWARTZ: -- as this program progresses.

GENERAL DAILEY: Thank you.

MR. AUGUSTINE: Rich, I would just observe that the simulator -- full flight simulator is as fine a simulator as I've seen, and the training facility is as fine a facility as I've seen. And at the risk of my colleagues getting tired of hearing me say this, the

simulators are still no better than our understanding of the physics that's behind them, particularly with regard to VRS. Our understanding is imperfect. And so the way around that is to have good and safe boundaries, which you're going to require some very careful testing if one goes ahead.

COLONEL SCHWARTZ: Sure.

GENERAL DAVIS: Rick, just for clarification, my memory of NATOPS changes or tech order changes -- "Over a thousand changes." That doesn't mean we've changed procedures. A lot of it's done for clarification of procedures in there. There may be some numbers off on, say, like tailpipe temperatures and things like that.

COLONEL SCHWARTZ: Yes, sir. That's a lot of what it is. This is a very large manual, as we'll go on to discuss, and it's complex. This is the first tiltrotor aircraft in the inventory, so it's a very complex and large manual, probably a lot larger and more complex than most initial aircraft NATOPS manuals that we get. And because of that, there are a lot of changes.

And as you spoke of, sir, these changes -- a lot of these changes are minor. They're corrections.

GENERAL DAVIS: Rebuilding and --

COLONEL SCHWARTZ: Rebuilding. Yes, sir.

GENERAL DAVIS: Okay. Thank you.

COLONEL SCHWARTZ: These are the possible conclusions that we have developed.

The MV-22 Aircrew flight training syllabi and their integration with ground training and simulator flights have been well thought out and documented.

The IMI ground training and Full Flight Simulators are state of the art.

Although adequate now, historical precedent suggests that funding may not remain stable throughout upcoming budget cycles.

The MV-22 Standardization Manual adequately addresses flight standardization within VMMT-204.

At this early stage in its development -- I spoke to this earlier -- the relatively large size of the V-22 NATOPS Manual is considered consistent with the fact that the V-22 is a complex aircraft and that this is the first operational tiltrotor aircraft.

The MV-22 NATOPS Manual is undergoing the same developmental growth experienced by previous NATOPS

Manuals; however, because of the challenges currently facing the MV-22, extraordinary efforts should be placed on the NATOPS Manual so that it reaches the necessary level of maturity before training resumes.

DR. COVERT: Rick, I would like to make a comment on the fourth paragraph up there.

COLONEL SCHWARTZ: Yes, sir.

DR. COVERT: I think that everyone should recognize that the V-22 was what was called in the past a "converter plane." It's a combination of an airplane and a helicopter, and that has many features that are desirable of each. It can hover, and no airplane can hover that I know of -- not successfully. It has high-speed equivalent to a turboprop commuter aircraft, which is well in excess of whatever it can -- a helicopter can fly.

But the point being, this is a separate, new, unique machine, and I think we ought to keep in mind in judging this that it is a new and unique machine. And I think this is going to result, as you pointed out, in initially a very thick flight manual as people try to decide what to retain from both airplanes and helicopters and what turns out not to be necessary and what may be

new. And I just think it's important for us to keep that -- this series of facts in mind, and thank you for the interruption.

COLONEL SCHWARTZ: Yes, sir.

MR. AUGUSTINE: In that regard, just a footnote. There are warnings spread throughout the manuals. Is there anyplace in NATOPS, up front, where it just has on one or two pages all the things you should never do just called out in one place?

There is?

GENERAL DAILEY: Well, limitations --

COLONEL SCHWARTZ: Limitations. Yes, sir, there are a whole series --

MR. AUGUSTINE: I'm thinking of something that's just a page. The manual is thick. Do you have to dig through it to find the warnings? I was wondering. I don't know. Is there somewhere in the front or --

COLONEL SCHWARTZ: Not particularly for warnings, sir. However, there are aircraft limitations -- a whole section of aircraft limitations that address a lot of those issues of --

MR. AUGUSTINE: How thick would that be?

COLONEL SCHWARTZ: I'd have to look, sir.

I don't know off the top of my head.

DR. COVERT: To build on Norm's suggestion, would it be prudent to have a list of the warnings in the front page of the NATOPS?

MR. AUGUSTINE: Let's ask our pilots. Are we re-inventing something here?

GENERAL DAILEY: Kind of. The NATOPS organization is -- they'll have a "limitations" section that lists all of those things you're concerned about, and then in the "emergency procedures" section is where all the warnings are also displayed.

MR. AUGUSTINE: Is there a summary?

GENERAL DAILEY: And then the actions to be taken when the warning appears.

MR. AUGUSTINE: Is that reasonably short? Those sections?

GENERAL DAILEY: The limitations are usually just a couple of pages.

MR. AUGUSTINE: Thank you.

COLONEL SCHWARTZ: We have two recommendations: Ensure adequate funding is provided for aircraft simulator maintenance and upgrades, and apply extraordinary efforts to complete updates to MV-22

NATOPS, Standardization and Tactics Manuals to support pilot/squadron transition training and re-currency training.

DR. COVERT: I'd like to go back a minute, please. I think I would like to have something in the bottom paragraph to continually complete the upgrades since this is an evolving process. We don't want to leave the impression that it's going to be in a final state for a long time.

COLONEL SCHWARTZ: We'll add that.

GENERAL DAVIS: I think the experience, Doctor, is that, you know, as we always learn more about airplanes -- I've never known a flight manual that I haven't had to add pages to once every quarter. I think clearly the NATOPS process and the Air Force process is exactly the same.

DR. COVERT: But it says "to complete."

GENERAL DAVIS: "Mature" I think is what the --

GENERAL DAILEY: Well, I think what -- Are you saying complete -- identify any changes now, but the process itself requires that there be periodic NATOPS reviews and conferences to do that very thing.

But one of -- What you're saying here, this is an area that is in good shape, it appears.

COLONEL SCHWARTZ: Yes, sir. Yes, sir, it does.

GENERAL DAILEY: And now what your concern is, is that if we start moving money around to fix other things, that this is an area that needs to be protected because it is doing what it's supposed to do. Is that --

COLONEL SCHWARTZ: That's exactly what we're trying to say.

GENERAL DAILEY: Is that a fair statement?

COLONEL SCHWARTZ: That's true.

MR. AUGUSTINE: I may be getting ahead of something here, but shouldn't it be stated somewhere that the simulator would be updated to include a VRS boundary with a very -- for the V-22, with a very clear consequence for violating it?

COLONEL SCHWARTZ: We'll cover that in the VRS discussion. We can go back and look at that later.

MR. AUGUSTINE: Fine.

GENERAL DAILEY: But it might not be worth -- or it might be worth re-stating it here.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: I mean, as General Davis talked about, making a clear demonstration of what can happen if you exceed the envelope in this area.

GENERAL DAVIS: Yes, sir. It seems to me that although putting all the physics of VRS in a simulator probably would be time-prohibitive and probably cost-prohibitive, there are techniques, as you can make the pilots very aware that they've penetrated an area which they don't belong in and you make it -- You just basically shut the simulator down.

So it is a superb technique to keep them aware of VRS or whatever we're trying to attack.

COLONEL SCHWARTZ: We can add a section for that here if the Panel wants.

There are three areas of downwash concerns that I'm going to address. The first one is Remote Area Operations. The second one is Personnel Deployment/Recovery operations, and the third one is Externals.

OPEVAL Report identified downwash effects as a major deficiency to successful deployment of the aircraft, so we went out and took a look at it. We talked to a lot of people, a lot of pilots. Landing in a

desert has always been a significant challenge, especially at night on the goggles: shifting topography, varied soil composition, changing in illumination. A lot of effects out there are very, very, very challenging for pilots on goggles.

Over the years, the Services -- both the Army, the Navy, the Marine Corps, and the Air Force -- have developed specific Tactics/Techniques and Procedures to address these challenges and they've had to go back and redo these every time we've invented a new night vision goggle device or a night vision device and incorporate it into our aircraft. So it's been an ongoing process.

Discussion with OPEVAL aircrews, both Air Force and Marine Corps, gave us a variety of opinions on the level -- the specific level of risk and a potential to be able to successfully address this risk.

On the other side of the house, the V-22 does incorporate the latest in NVD technology. The ANVIS-9 goggles are out there in the fleet now. They're the best goggles the fleet has had. The aircraft incorporates an NVG heads-up display that clips onto the reticle of the goggles and allows the pilots to view

their airspeed, altitude, and the basic parameters while looking through the goggles, which allows them to maintain their field of view basically outside the aircraft and not have to come back into the cockpit, which is very important when you're flying goggles.

Additionally, the aircraft also has a Forward Looking Infrared radar which can significantly aid in night desert landings.

One of the other factors that we considered was the extended range of the V-22. It provides a lot greater capability to reach acceptable landing zones. A normal helicopter, limited by its range, you sometimes have to land not in the best spots; but with this aircraft, you're going to have the ability to range a greater number of LZs.

Next slide, please.

GENERAL DAILEY: Go back. We need to -- There needs to be a change on that slide. That should be a "Forward Looking Infrared." Capital "R" on the "red," and get rid of the "radar" there.

COLONEL STEEL: We got it, sir.

GENERAL DAILEY: Okay. But what you're saying here is that a brownout or whiteout is a factor in

any helicopter landing and that this airplane has additional cue devices that could make it better, and tactics or operational techniques would probably be the rest of it.

COLONEL SCHWARTZ: Yes, sir. Brownout is a significant concern with all our aircraft -- all our helicopters. This aircraft has greater downwash effect than most helicopters, if not all, so it's a significant issue. But because of the technology we have available to us, we believe that -- and we'll get into this, but tactics and techniques and procedures can be developed to overcome some of these deficiencies.

Possible Conclusions.

As I said, the V-22 has greater downwash than most helicopters, but is configured with enhanced Night Vision Device capability and has the ability to reach a far greater number of landing zones. Testing in a desert environment to date has been insufficient to fully develop appropriate techniques and procedures.

Potential Recommendations.

The services should continue to develop procedures and techniques for the high downwash "desert brownout" situation. The resultant procedures and

techniques should be included in the training manuals and training syllabus. A tactical unit night operations in landing zones that have the potential for brownout should be restricted until procedures and techniques are developed.

One of the conclusions we reached was that it may well be that the most important tactics, technique and procedure that we develop for this aircraft may be in the selection of the landing zone that it lands in; because it has a greater ability to find a potentially better landing zone, that should mitigate some of the problems.

GENERAL DAILEY: So like we just said, this is a bad situation for any helicopter --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: -- and this one is no different.

COLONEL SCHWARTZ: No, sir.

GENERAL DAILEY: Is it worse, or better?

COLONEL SCHWARTZ: It is probably worse because of downwash effects, but we really don't think that adequate testing has been fully explored.

GENERAL DAILEY: And who should do the

testing?

COLONEL SCHWARTZ: The folks at MAWT-1 in conjunction with HMX-1.

GENERAL DAILEY: So this is an operational test as opposed to a development test, then.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay.

COLONEL SCHWARTZ: The Joint Operational Requirement for the V-22 requires that the aircraft have the capability to employ two fast ropes off the ramp, one out the cabin door, and fast rope insertion/extraction system, stabilized extraction rigging and rope ladders through both the ramp and the cabin door.

Based on the poor developmental test performance, the Program Office does not believe that the fast roping/rappelling operations from the cabin door is going to be an option for this aircraft and they're recommended a change to the JORD to reflect this.

Now, Special Patrol Insert/Extraction (SPIE) missions from the aft cargo hook hole and the rappel mission were both executed satisfactorily.

V-22 was assessed as having the capability to meet the JORD requirements for helocast by traditional

techniques under daylight conditions, but the aircraft isn't equipped right now with a coupled hover capability, so night helocast was not done.

GENERAL DAILEY: So that was a safety consideration not to do it?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Is that coupled hover going to be installed --

COLONEL SCHWARTZ: It is going to be installed in the Air Force version, sir.

MR. AUGUSTINE: Have two people fast-roped at one time out the aft --

COLONEL SCHWARTZ: Yes, sir, they did, and there are some issues with that as far as the spacing goes. There's --

MR. AUGUSTINE: Right. But it has been done with two people?

COLONEL SCHWARTZ: Yes, sir.

Lack of rope ladders or a suitable hoist precluded the evaluation of the Special Operations Forces over-water-recovery. There are problems with the hoist. The Program Office is looking at those issues. No rope ladder is currently certified for operations with the

aircraft, and that's another concern.

GENERAL DAILEY: And these are all downwash issues.

COLONEL SCHWARTZ: These are downwash issues. Yes, sir.

GENERAL DAILEY: All right.

COLONEL SCHWARTZ: The concept of personnel deployment from a hovering V-22 has been partially demonstrated. Several JORD requirements in this area remain to be demonstrated, and tactics, techniques procedures need to be developed to be able to successfully do them.

MR. AUGUSTINE: I don't remember in any of our briefings -- and I maybe just don't remember -- but were we briefed at all on problems with the downwash on crew members on board ship?

COLONEL SCHWARTZ: No, sir, we weren't.

MR. AUGUSTINE: Was that a problem, do you know?

COLONEL SCHWARTZ: There's nothing that I've read that indicated that it was a problem, and it wasn't addressed in either the OPEVAL or the --

GENERAL DAILEY: But we did have -- in one

subpanel, we had some discussions about the fact that the impact on the individual is different with this airplane. It gets you lower, and so you're crouching in a different way. But it's not something that's --

MR. AUGUSTINE: It wasn't a problem.

GENERAL DAILEY: It was considered to be operationally suitable in that regard.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Yes. But it is -- it's a different blast that you're getting.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: In some ways better, because it's not hitting you in the face, but it also can -- It could be a balance situation.

GENERAL DAVIS: Those of us with a lower center of gravity are going to do better.

MR. AUGUSTINE: I wouldn't know.

COLONEL SCHWARTZ: The recommendations that we developed are:

The services should revalidate the requirements for Personnel Deployment and Recovery operations. If these requirements remain valid, then these systems should be incorporated into the aircraft as

soon as possible. Follow-on testing and evaluation is required to address tactics, techniques and procedures to be utilized in the conduct of Personnel Deployment and Recovery operations.

GENERAL DAILEY: So the requirement to -- these requirements you're talking about, it's fast roping and what else? The ladder and the hoist?

COLONEL SCHWARTZ: Yes, sir. The ladder and the hoist.

GENERAL DAILEY: And as stated, they can't be done because there's no rope ladder that qualifies and there's no --

COLONEL SCHWARTZ: There's no certified rope ladder, and the hoist is inadequate at this time and it needs to be redesigned.

GENERAL DAILEY: And the fast rope cannot be done from the cabin door? Is that the idea?

COLONEL SCHWARTZ: Yes, sir. That is the issue.

GENERAL DAILEY: It's too close to the rotor?

COLONEL SCHWARTZ: And they may look at -- The Program Office has stated that they may look at

moving the hoist from the cabin door where it was originally slated to be.

GENERAL DAILEY: Okay. So this is a double thing. The users have to validate the requirement.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: And if it remains firm, then we're talking about a redesign of some of these capabilities in the airplane.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay.

COLONEL SCHWARTZ: The next discussion is External Loads.

The OPEVAL report did not identify downwash as an issue during external load operations; however, a subsequent "white paper" that was given to us by the Director of Operational Test and Evaluation stated that while external load operations were possible, "they remain a significant challenge."

While external load capability was demonstrated during OPEVAL, downwash effects on ground personnel may be a challenge to its successful introduction to tactical operations.

Now, they did a number of external operations during the OPEVAL. The concern was that it took an inordinate amount of time for the people working under the aircraft to hook and unhook the loads. We believe that this needs to be explored a little bit further.

GENERAL DAVIS: Well, Rick, this is not a problem particular to the V-22. I mean, we had --

COLONEL SCHWARTZ: No, sir.

GENERAL DAVIS: The 53 had a problem.

COLONEL SCHWARTZ: The 53-E's have a significant challenge, too, because it has a significant downwash.

Part of the problem with this aircraft is downwash is different around the aircraft, around the perimeter of the aircraft, depending on the flow. So it's stronger in some places and less in other places, and that's going to require training to find out where it's best to approach the aircraft from for the crews and where it's best to leave underneath the aircraft from.

DR. COVERT: Rick, it may be because of the lateral placement of the proprotors that the carrying over distance might require review of operational --

COLONEL SCHWARTZ: Yes, sir. And that's what we're recommending, sir. Our recommendation is that follow-on testing evaluation be conducted to further refine the tactics, techniques and procedures, and to look at the downwash effects from the proprotors to ensure that external load operations can be conducted safely and effectively, and we think this is a training issue.

DR. COVERT: I think it's doable. I just think it may be different, just like other things have been different because of the rotor location.

COLONEL SCHWARTZ: It was demonstrated to be successfully doable. Yes, sir.

GENERAL DAILEY: This is another operational test as opposed to development test?

COLONEL SCHWARTZ: Yes, sir, it is.

GENERAL DAILEY: Okay.

COLONEL SCHWARTZ: There are two specific situations in the V-22 which may require it to autorotate: a dual engine while in conversion or helicopter mode, and the loss of a single engine coupled with an Interconnect Drive Shaft failure in the conversion mode.

The program has determined that the risk of a dual engine failure or a single engine failure with an ICDS failure -- Interconnect Drive Shaft failure -- would be improbable. It's also indicated that the probability of a single engine failure coupled with an ICDS failure is two orders of magnitude greater than the probability of the aircraft having a dual engine failure.

While there are emergency procedures established in NATOPS for dual engine failures, there are no procedures that address the loss of one engine with a subsequent loss of the ICDS.

Additionally, NATOPS emergency procedures call for conversion to airplane mode after the loss of an engine. They then suggest landing in VTOL mode. There is no one-engine-inoperative precautionary -- glide -- landing procedure. This leaves the pilot vulnerable to autorotation should the operating engine or ICDS fail on final.

During V-22 Development Test, autorotative descents were conducted in the aircraft and autorotations to a landing conducted in the simulator.

V-22 demonstrated stable autorotative descents in flight test and offered enough control to the

pilot to touchdown at a survivable rate of descent.

Evaluations in the simulator have shown limited repeatability of making a safe landing at the touchdown phase.

While autorotations are problematic for the V-22, it has been demonstrated through testing and simulation that power-off glides in the airplane mode can be successfully executed to a hard surface runway as performed in other fixed wing aircraft having similar glide characteristics.

The probability of the V-22 being forced to execute an autorotation vice a power-off glide is considered low for these particular reasons. First of all, the employment concept: the aircraft was designed by Marine Corps to be employed 70 percent of the time in fixed wing mode and only 30 percent of the time in rotary wing mode.

There are specific design characteristics that enhance this: the high reliability of the engines; the separation of the engines on the outboard wings -- they are not close together, so a round or a surface-to-air missile impacting would not take out both engines at the same time -- vulnerability features built

into the aircraft, and the lack of a tail rotor. Also, the fact that emergency procedures training given the pilots tell him to go to the airplane mode first after a first failure.

Additionally, one thing that we looked at and discussed was the crashworthiness features that are built into the V-22 to maximize the potential for occupant survivability should a crash landing occur.

And these are significant and include the broom sticking of the proprotors, the bulkhead that -- The wing will separate from the cabin if it lands hard going forward so it won't hurt the crew within the cabin area. So there was significant features built into this aircraft in the event that it does land hard.

GENERAL DAILEY: Are we going to talk about vulnerability later? Are there other issues that cover that? Because it might be worth discussing --

COLONEL SCHWARTZ: This might be the time to do that, sir.

GENERAL DAILEY: Yes. You've talked about the fact that the airplane -- it's unlikely that it will have to do this because of several things that are built into the design, but in combat operations, vulnerability

is another consideration in terms of -- Do we look at the live fire testing that was done against this and the other vulnerability testing in terms of its --

COLONEL SCHWARTZ: Yes, sir, we did, and it stacked up very well and performed very well through live fire testing.

GENERAL DAILEY: All right. So what you're saying is that the procedure is if you lose one engine, you go to the airplane mode. You may already be there for, but depending on where you are in your flight...

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: And then you make a vertical landing, however.

COLONEL SCHWARTZ: That's what's in the manuals right now.

GENERAL DAILEY: Single engine vertical --

COLONEL SCHWARTZ: And the question that we had when we took a look at it is, is this the best thing? In a fixed wing aircraft, of course, there would be procedures established. You'd go to a high key, for instance.

GENERAL DAILEY: Okay. But, now, that's

for the double engine failure.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: And at that point, then you're in the same mode that you'd be in a transport aircraft with both engines out or whatever.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: And you're going to -- And then the airplane has been designed so that the rotors themselves, when they hit the ground or if they do, that they don't fragment. They actually broom-straw, or whatever the --

COLONEL SCHWARTZ: They broom-straw. Yes, sir. They'll separate so shrapnel won't go through the cabin.

GENERAL DAILEY: So it was designed to do this, then.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: To land in the airplane mode under extremis.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAVIS: The reason for the "high key" comment, sir, is that basically, you know, if you're having trouble with the airplane, if you're concerned

about the cross-connect, the high key puts you at the optimal position that if, for some reason, the other engine goes, as you know, and enhances the probability of you getting on the runway or the road or even a field.

GENERAL DAILEY: The reason I -- Autorotation has been a high visibility issue with this airplane, particularly in the press, because it's the way helicopters land in an emergency.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: But since this airplane has more options, then the fact that it's not -- Autorotation is probably not even the first choice, then. Is that what we're saying?

COLONEL SCHWARTZ: We'll get to that in the conclusion, sir. If you'd like to go to the conclusion, we'll talk about that.

GENERAL DAILEY: Oh, are you?

DR. COVERT: Would you go back for me, please?

COLONEL SCHWARTZ: Yes, sir.

DR. COVERT: And I would suspect under design characteristics, invulnerability features might present a different view than vulnerability features.

COLONEL SCHWARTZ: We'll make that change, sir.

DR. COVERT: Thank you.

MR. AUGUSTINE: I guess I have to interject. To go to the airplane mode after the first failure is still a pretty sticky situation in the sense that you've got to be able to get into the airplane mode, and I presume there's some failures that would make it hard to get into an airplane mode. And once you get it into the airplane mode, as you pointed out, you've still got to land, and you're not going to land in a pure airplane mode. You've got to get back to an intermediate mode.

GENERAL DAILEY: Well, that was kind of my point. You could, though.

COLONEL SCHWARTZ: You could, sir.

MR. AUGUSTINE: Worst case.

COLONEL SCHWARTZ: If you were in extremis; you were heavy; it was a hot day; you didn't have the power possibly to convert or felt you had the power to convert, you could land in the glide mode.

MR. AUGUSTINE: Okay.

COLONEL SCHWARTZ: Possible Conclusions.

The V-22 has limited autorotational capability; that the V-22 possesses even some ability to autorotate sets it apart from fixed wing aircraft; that it possesses the ability to conduct a survivable power-off glide landing sets it apart from all helicopters.

There are no emergency procedures in NATOPS for a single engine failure coupled with an ICDS failure, a situation that would require a power-off glide landing or an autorotation.

The V-22 community does not appear to place enough emphasis on the glide landing capability of the aircraft as an alternative to autorotation, especially in the one-engine-out procedures.

And I believe that's what you were talking about before, General.

Employment concept, design features and pilot training will limit the probability of an autorotation having to be conducted.

And crashworthiness features significantly enhance survivability over that of legacy platforms.

Recommendations, please.

These are our recommendations.

The services should reassess the

requirement for autorotative flight.

If the requirement for autorotation is valid, the V-22 Program should improve the capability of the V-22 to conduct autorotations.

Assess the feasibility of safe landing with the combination of engine and ICDS failure, and incorporate appropriate procedures in the NATOPS and training syllabus if necessary.

Re-assess the capability of the V-22 to conduct power-off glides.

NAVAIR ensure that the full flight simulator used by pilots at Marine Corps Air Station New River accurately emulates both autorotative and power-off glide simulations to the degree required for effective pilot training.

MR. AUGUSTINE: Rick, on bullet two, to recommend that the programs should improve the capability to conduct autorotations, that's pretty fundamental to the design.

COLONEL SCHWARTZ: Yes, sir, it is.

MR. AUGUSTINE: In other words, I'm not sure what you would do.

Can somebody help me?

GENERAL DAILEY: Add weight to the rotor blades, which you really don't want to do.

COLONEL SCHWARTZ: There are some limited things that you could probably do, but --

MR. AUGUSTINE: Anything I could think of you would do would be a major redesign. You're talking about different rotor diameters and pitch angles, and all kinds of -- I wonder if that should even be on there.

DR. COVERT: Well, the rotor diameter, if I recall correctly, is fixed by the need for shipboard operation.

MR. AUGUSTINE: I think it's a dead-end.

DR. COVERT: So I think that some of the other schemes I've heard discussed strike me as pie-in-the-sky or impractical for a variety of reasons. Nonetheless, I think it should be reviewed.

GENERAL DAILEY: We can recommend that the second bullet be removed as a recommendation.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAVIS: Well, I'm not sure, Mr. Chairman. I mean, we say they ought to reassess the requirement. And it doesn't have great autorotative capabilities, and if that is a requirement, then wouldn't

it be inherent on the Department of Defense to improve its autorotative capability?

MR. AUGUSTINE: Well, I guess you could look at that way. I just think to hold out any hope that one is going to significantly change the autorotative capabilities of this airplane is just very small.

GENERAL DAVIS: Well, practically, I agree with you. Yes, sir.

DR. COVERT: Well, I think it goes back, General, to the idea that -- what are you going to trade off for this? You can't, in an airplane in this stage, make a substantial change in one place without losing something someplace else. So I think it goes back to trying to decide what you want the airplane to do and whether or not this requirement is appropriate.

I think, as I said before, "needs to be reviewed." I think I said "reviewed," not "removed," sir.

GENERAL DAVIS: No. No, I understand, Doctor. But --

GENERAL DAILEY: Mr. Augustine recommended removal. I was not quoting you, sir.

But I think the point is that this

airplane has more options when you lose an engine than either an airplane or a helicopter.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay. And so what we need to do is -- or what NAVAIR needs to do is to figure out what the best way under various conditions would be. And it may be that you sacrifice the proprotors because that's the best way to do it. I don't know.

But shouldn't we recommend that they -- whatever they determine the best way under conditions of altitude and mountainous terrain, overweight, or whatever it might be, and then clearly specify what that is under these conditions and then put it into the trainers to train people to use those procedures?

That's kind of what we're saying here, isn't it?

COLONEL SCHWARTZ: Yes, sir, that is. That's exactly what we're trying to say.

GENERAL DAILEY: So whether it can or can't, somebody needs to figure that out. But it looks like it's -- We've said it's marginal and even not always repeatable. No matter how good you are, you're going to have a bad day on some occasions, and so -- But in this

situation, it's an emergency anyway. You've lost something or more than one thing that's put you in a bad situation.

But we're saying that this airplane has options available to you that are not available with any other aircraft because of the combination of the two. And also, if you have a round-out that's -- where you hit the ground hard, you have survivability features built into the aircraft that are going to make it a better deal for the people who are in there than it would have been in other aircraft.

Is that --

COLONEL SCHWARTZ: Yes, sir, that is. And one of the issues is we don't believe they've adequately addressed all of those options they have available to them, particularly with the power-off glide.

MR. AUGUSTINE: Would you think it was fair to say that this airplane has more options than either a conventional rotary wing or conventional fixed wing aircraft for emergency landing, but neither of the options are as good as for a pure rotary wing or for a pure fixed wing aircraft?

GENERAL DAILEY: Well, not all helicopters

have good autorotational capability.

MR. AUGUSTINE: But almost all will be better than this.

GENERAL DAVIS: As I remember, all autorotations are under emergency procedures anyway.

MR. AUGUSTINE: Yeah. I guess, you know, the statement is probably true, but I would hate for us to give the impression that we have much hope in this.

GENERAL DAILEY: Well, that's kind of my point. Not that we would decide here whether it will or won't, or can't, but we ought to come up with a recommendation that tells people what we think they ought to do in terms of determining what it can do and then what action to take after that to make sure that the crews are properly prepared to react in the best way possible.

In any emergency, the final determination is left to the pilot anyway. They give you advice, but you do whatever you have to do. And so it may be that this thing would autorotate someday, but that doesn't look like that way would be the first option if you're flying it.

COLONEL SCHWARTZ: No, sir.

MR. AUGUSTINE: I think it's how we present it. If the future of this airplane depends on making a design change that gives it good autorotation capability, don't bet on it.

DR. COVERT: Rick, I would suggest in the fourth paragraph that -- I hate to be specific because I think other people know a lot more than I do, but I would think that in reviewing the capability of power-off gliding, they ought to consider the possibility of being able to feather the proprotor so that the blades effectively present a minimum drag to the airstream and might improve the drag ratio -- the lift drag ratio.

COLONEL SCHWARTZ: Okay, sir. We can add something like that.

GENERAL DAILEY: That might be the place to spend the money if it appears that the airplane mode is the preferred emergency landing mode, then to assess, you know, the benefits of going to a -- having a feather capability -- if it's not there, have a feather capability and -- That kind of gets back to "figure out the best way to do it and then spend your money on making that as good as it can possibly be."

COLONEL SCHWARTZ: We can add that

recommendation -- take a look at possible feathering of the proprotors for power-off glides. Yes, sir.

Any other questions?

I'll be followed by Mr. O'Connor.

MR. O'CONNOR: An admin note. I've been asked to let the public know that there are going to be handouts of these slides as presented at the end of the presentation.

Now, the reason for the timing, of course, is that this is the first time the whole Panel has seen these and it's not appropriate that anyone see them before the Panel, but we certainly have these available at the end.

The next subject -- again, still on the overall safety topic -- is an overall question that has to be addressed. And that is, what are the safety implications of the tiltrotor concept in general?

The way we did this was we looked at the results of the mishaps, and then we looked at all of the issues that are currently being tracked by the Program that are a safety risk or hazards. And we looked at a -- sort of a top-level comparison to make this distinction on tiltrotor unique.

If you compare this aircraft with all known aircraft -- helicopter and fixed wing -- there's really nothing that you can say that is unique. What's unique about the tiltrotor is the configuration of a lot of non-unique equipment in a unique way.

And so to make that comparison, we had to compare it to something, and we chose a helicopter, state-of-the-art, fly by wire, that has the same sort of mission as the V-22, and I'll talk to you about that in a minute.

First of all, the mishaps. We looked at the five major tiltrotor mishaps. Five -- I have included XV-15 prototype that crashed early in the history, and we found in the write-ups of all those mishaps that tiltrotor unique technology was not found to be a cause factor in any one of those. However, in our assessment, we have to say that in three of those mishaps there was a tiltrotor unique roll response to an initial failure that you would not have seen in a helicopter.

Then we looked with that same set of glasses at all of the existing hazards that are currently tracked in the system safety program that the Navy conducts for any aircraft, and less than 6 percent of all

the system safety risks could be called tiltrotor unique.

Now, this is the comparison where we looked at the V-22 tiltrotor configuration versus a state-of-the-art helicopter; same mission, same size, but fly-by-wire kind of system.

GENERAL DAVIS: Excuse me, Bryan.

(Discussion off the record.)

MR. O'CONNOR: Now, of those 6 percent that we could call tiltrotor unique compared to an equivalent helicopter, we found that none of those were in the high-risk area. They're all in medium to low. There were some unique safety challenges, though, among those 6 percent.

First, you've already heard about autorotative performance. Because of the high disk loading of this aircraft, it does not do well on autorotative descent. The second is, propensity for rapid development of a high sink rate, which we have heard from the pilots. Third, roll response to VRS or any other asymmetric proprotor condition when the aircraft is in its VTOL mode. And fourth is a high downwash velocity, which you've already heard about. Again, that's another aspect of the high disk loading.

There are also tiltrotor unique safety enhancements. One is the low chance of having to ever do an autorotation due to low vulnerability -- the speed, the range, the engine placement you've heard about -- the ability to convert to airplane mode and the lack of a tail rotor, which is one of the reasons why single rotor aircraft have to do autorotations -- is for loss of that single point failure mode.

There's also, as mentioned in the OPEVAL report, a very good field of view for pilots during decelerating transitions. When they come into a landing, they don't have to pull the nose up and decrease their visibility. They just pull the nacelles back and keep the attitude of the cockpit level, and that was considered enhancing from a safety viewpoint.

Also, a little bit of a counter to the earlier one that says it's easy to get into high sink rate. They also find that there is the promise of a good sink rate margin with this aircraft for the very same reason. High disk loading says that you'd probably have to develop a little bit higher sink rate to get into trouble with this aircraft than with aircraft with lower disk loading.

Implications of Tiltrotor Concept, Potential Conclusions.

The tiltrotor technology introduces several safety-related challenges as well as enhancements to medium lift mission.

When considered in total, the tiltrotor unique risks do not appear to be insurmountable, nor to outweigh the enhancements.

All tiltrotor unique risks appear to be manageable through design modifications and operational procedures and techniques.

Recommendations.

Continue to develop mitigation strategies to limit the potential for autorotation and the risk of asymmetric thrust conditions.

Second, specific recommendations are included in the VRS, the downwash, and the autorotation issue briefs, which you've already had.

Any questions or discussion on the overall concept?

Then we'll go to System Safety Program.

GENERAL DAILEY: Just a second, Bryan. I need an admin...

(Discussion off the record.)

(A brief recess was taken.)

MR. O'CONNOR: The next issue is System Safety Program. We looked at the program to make sure it's being managed properly, staffed probably, using appropriate processes and procedures.

Given the emphasis on safety that was part of our charter, we talked to the people are who managing and operating the System Safety Program for the V-22 Program, both contractor and government, and we found that they have -- they're managed by a system safety professional with adequate Bell/Boeing support and extensive experience on the program.

The program complies with appropriate system safety standards.

The system safety program is appropriately integrated into the program's risk management and decision-making.

The V-22 Program categorizes risks, however, in what we considered to be a conservative way, and I'll cover that in the conclusions -- Well, I should give you a little more than that.

For example, a single engine failure and a

dual engine failure are both in the same category of risk, and that's because they tend to treat that category more conservatively than they absolutely would have to normally. Some of these things would probably be more appropriately placed into the lower risk category.

The purpose -- or the reason for that is that an aircraft, this early in its life, has a lot of uncertainties and they tend to be biased towards the conservative side when they address safety issues. The number of high and medium risk issues in the program, closed out by the program -- that is, accepted -- is reasonable when you compare it to other ongoing aircraft programs and programs at this stage of development, and that was -- we got that from the head of the system safety organization of NAVAIR.

And before OPEVAL, NAVAIR conducted a flight readiness review and the system safety organization was part of the "go" that came with that, as well as the groundings that have happened throughout.

Conclusions.

The V-22 System Safety Program is appropriately staffed and engaged.

The number and type of risks being tracked

by the program do not appear to be abnormal for an aircraft at this stage in its development.

The V-22 program uses an overly conservative standard to define risk level for it's various safety issues: the result is that the risk level categories by themselves are of limited use to the decision-maker in safety risk mitigation trades, one to the other. They have to go to other measures other than these risk category trades or levels.

Potential Recommendations.

NAVAIR should develop a consistent approach to measuring overall risk level and developmental programs to aid the program in risk trades and other decision-making; NAVAIR, in the fight readiness review process, and the Defense Department in its acquisition decisions, or -- this was one of those where I need a decision on which one would be more appropriate -- NAVAIR should require all programs to perform probabilistic risk assessments consistent with the recent quantitative risk category definitions that they've come up with.

GENERAL DAILEY: Well, what you're saying -- there's a program in place that appears to be doing

what it's supposed to do.

MR. O'CONNOR: Right.

GENERAL DAILEY: And that they're on the conservative side in terms of their risk assessments.

MR. O'CONNOR: That's correct.

GENERAL DAILEY: Is this inconsistent with the accidents that we'd had or mishaps that we've had in terms of if we have a program that's up and running, doing what it's supposed to do, why are we having these problems? Is that a fair question at this point?

MR. O'CONNOR: It's always a fair question. It's almost impossible to answer. It's one of those things that, before the mishap, people thought they were doing the right thing; they thought they had the appropriate level of mitigation on risks, and so on.

When you look at the System Safety Program, all we could determine was that it appears to be a little more conservative in raising issues to the program than it needs to be in some areas simply because, right now, for example, they have a single engine failure and a dual engine failure both in the same category of risk. And, yet, when you talk to the reliability people, they'll tell you there are five orders of magnitude

difference in probability of one engine failing in a given hour versus two engines failing in a different hour.

And the question there is, should the Program Manager be presented with both of these things as equally valid things to work on? And that's the issue here.

GENERAL DAILEY: The reason I'm asking the question, if we were to select option one up there, would we then be saying that we're recommending that they be less conservative in their approach? What you're saying is somebody needs to --

MR. O'CONNOR: That's correct.

GENERAL DAILEY: -- set standards and...

MR. O'CONNOR: The only reason for that is that the one dilemma that -- It's okay to be conservative in your approach, but you become a safety flag-waver and you can't separate the wheat from the chaff.

GENERAL DAILEY: So maybe they're spending time on things that are not of as great a significance as others that --

MR. O'CONNOR: That's correct.

GENERAL DAILEY: -- should get more,

correct?

MR. O'CONNOR: It's difficult, using the System Safety Program by itself here, and simply using these risk categorizations. It's difficult for any decision-maker to balance risks appropriately.

GENERAL DAILEY: I guess I have a little problem -- I'm not sure that that first statement conveys that message.

MR. O'CONNOR: Okay.

GENERAL DAILEY: Am I missing something here?

MR. AUGUSTINE: I read the second one as being a possible subset to the first.

MR. O'CONNOR: It could be.

MR. AUGUSTINE: It's a possible way to do the first. And to your very first point, I had the same reaction two charts back. The second bullet said basically that the safety program meets the standards, and then the question comes up: Well, if it meets the standards, why do we lose aircraft?

Yes, there it is. The second bullet. I think that needs some elaboration or modifying. It may meet current safety procedures or something like that --

MR. O'CONNOR: Right. It meets the standards for the type of process that needs to be put in place; the type of analyses that are supposed to be done. We didn't find any fault with how they're doing the system safety job. I'm not -- The only way I could think of to improve it might be to present their findings in a little more useful form to the Program Manager so that he can put appropriate attention on the appropriate risks rather than presenting him with 60 1D risks, for example, when --

GENERAL DAILEY: Oh, I see.

MR. O'CONNOR: -- you know that certain of those are more important than others. The System Safety Program that they're complying with here does not allow for that.

GENERAL DAILEY: Okay. So what you're saying is that by being conservative, there are too many things in this --

MR. O'CONNOR: Too many things that are in the same category as important things.

GENERAL DAILEY: It could even dilute his attention to --

MR. O'CONNOR: What I'm worried about is

it may dilute the really big ones, and that's the only fault I could find with this whole process.

MR. AUGUSTINE: You clearly want to do "B," I would think, and you may want to do some of "A."

MR. O'CONNOR: "B" is not without --

DR. COVERT: I would suggest that the first thing you want to do is go through these 1Ds and try to use common sense and sort them out.

1B sounds good, but I think when you're starting to talk about probabilities in the order of one and ten to the ninth exposures and so forth, I begin to have some difficulty trying to figure out how I am going to do that. I can't run a test the rest of my life or I will never fly the airplane.

MR. AUGUSTINE: Well, I read "B" to be what this category 1B, 1D, 2 --

DR. COVERT: Well, I think there are people who are called "probabilistic risks analysts," and I think at this point that's sufficiently immature that we probably would prefer not to --

MR. O'CONNOR: It's not a panacea. Right now, I can tell you that when they have a lot of 1Ds, the Program Manager is very aware that when he gets a stack

of 1D issues, that he has to go to other questions to parse them out and separate the wheat from the chaff. The only suggestion here is that the system safety process can help with that.

DR. COVERT: That's right.

GENERAL DAVIS: Mr. Chairman, I think we all agree that if you have too many located in one category, the real important ones could get lost in the noise level, and I think we ought to modify the -- recommend to modify the program so that noise level can be broken out in different categories so that the Program Manager, the safety managers, and all those folks can be looking at the most important ones.

I would recommend that we ask the staff to go back and rewrite the recommendation so that that becomes clearer.

MR. O'CONNOR: We can do that.

DR. COVERT: Yeah, I think that's right.

MR. AUGUSTINE: I concur.

GENERAL DAILEY: Are we all in agreement, then, on that? Okay. Because since we didn't understand what we were recommending here, it's probably a good idea to change it.

MR. O'CONNOR: Right. Yes, sir.

GENERAL DAILEY: Okay.

MR. O'CONNOR: Now, the next factor here in system safety area was the DOT&E briefing that we got early on in our meetings. The DOT&E assessment of the OPEVAL was conducted. We had their report. They mentioned a few safety issues. Obviously the VRS accident was one of those safety things that came out of OPEVAL.

The DOT&E briefing to our Panel included a substantial number of things labeled as safety issues and potential problems, and so we felt like we had to go and take a look at those. And what we did was we bounced them across all the known safety issues and hazards in the program to try to find out if there was anything new that had come out of this analysis that either NAVAIR had missed or that the OPEVAL people had, and the result of that was that there were no new things that came out of their analysis.

There were 15 generic issues that were covered by existing safety action records that are on the program, and that the remainder of those things that were mentioned in that briefing to us were either low-risk or

were more reliability or availability than safety issues.

So the conclusion there is, we took the challenge that was presented to us by the DOT&E community to look at this. We know that although at least one new safety issue came out of the OPEVAL flying, there were no new safety issues nor changes in the V-22 hazard risk level assignments as a result of the analysis that was conducted by DOT&E. Recommendations.

To aid the decision-makers, DOT&E and OPTEVFOR both should consider use of standard risk indices -- i.e., the system safety Risk Assessment Codes -- the ones we just bad-mouthed here a minute ago -- but at least -- at least that would be very helpful to people trying to make sense out of operational safety issues that come out.

GENERAL DAILEY: So we're saying that the analysis of the DOT&E issues show that all of those were already being considered --

MR. O'CONNOR: That's correct.

GENERAL DAILEY: -- as part of some other activity that had taken place prior to that?

MR. O'CONNOR: Right.

GENERAL DAILEY: And that it's the lack of

consistency of the severity of a risk or understanding of that, that also impacts on this? So whatever we come up with on how we --

MR. O'CONNOR: That's correct.

GENERAL DAILEY: Okay.

MR. O'CONNOR: We tried to find -- We tried to take those 175 issues and put them in the right kind of boxes so we knew what to do with them, whether they were new, and if so, how potentially bad they were.

GENERAL DAILEY: So you could have 175 items but theoretically not have a severe safety problem, or you could have three and have a terrible safety problem.

MR. O'CONNOR: That's correct.

GENERAL DAILEY: Okay.

MR. O'CONNOR: That's why we had to look at every one of those and make sure they didn't miss something.

GENERAL DAILEY: Okay. And it's the problem of being able to sort these out --

MR. O'CONNOR: Right.

GENERAL DAILEY: -- that is impacting on the efficiency of the program.

MR. O'CONNOR: That's correct.

GENERAL DAILEY: All right.

MR. O'CONNOR: The next is Quality Control, and Colonel Steel will talk about the quality control issue.

COLONEL STEEL: As background information, initially the production in the program suffered from quality control problems, but quality improvement processes have steadily improved the aircraft. For example, the aircraft delivered in 2000 had 35 percent fewer discrepancies than those delivered in 1999.

We've taken the listings of the top readiness degraders from the fleet and we've assessed the quality measures used to correct them. We show five samples -- three on this slide, two on the next -- including their current status.

Each downgrader had a team appointed to assess and correct the discrepancy. All deficiencies have corrective actions in place or under review.

Of note: In the last bullet area, you'll notice that a Tiger Team has been appointed and they're currently assessing or conducting a complete aircraft review.

Conclusions.

The affected agencies need to continue to pay close attention to the quality control measures; the fleet degraders are an effective means to track progress and monitor status; and the preliminary Tiger Team indications are that there are still production variances between aircraft.

Recommendations.

We need to continue to monitor the quality processes and resolve the findings of the Tiger Team results when they become available.

GENERAL DAILEY: This is almost the same as the safety issue. We're saying we have a program that's in place; that's properly structured, properly staffed --

COLONEL STEEL: And effective.

GENERAL DAILEY: -- and is doing what it's supposed to do --

COLONEL STEEL: Yes, sir.

GENERAL DAILEY: -- and we're reducing the number of discrepancies on aircraft that are received. And then I guess it's a positive thing, you're saying, that they've identified these top ten or whatever it is,

areas of --

COLONEL STEEL: Correct. Those are --

GENERAL DAILEY: And then have a special team that's set up to continue to pursue this. The team is part of the quality process?

COLONEL STEEL: Exactly. Yes, sir.

GENERAL DAILEY: Okay.

COLONEL STEEL: Overall, it's a very high-quality program in monitoring the production qualities, et cetera. This Tiger Team that's been appointed, the preliminary indications do give us some concern, and those findings need to be tracked and monitored carefully.

GENERAL DAILEY: I guess we'll talk about this later, but can we assume that reliability and maintainability will improve because of what we see here?

COLONEL STEEL: Yes, sir.

GENERAL DAILEY: This is part of the process to get them there?

COLONEL STEEL: Exactly.

GENERAL DAVIS: Mr. Chairman, as you know, there's always a learning curve with every airplane, and the more we find out about it, the steeper that learning

curve goes. It looks like they're on that learning curve. I think the primary thrust of this recommendation is to say, "Good work, but keep going."

COLONEL STEEL: Exactly.

GENERAL DAILEY: This Tiger Team is a new initiative?

COLONEL STEEL: Correct.

GENERAL DAILEY: Okay.

COLONEL STEEL: Yes, sir.

GENERAL DAILEY: So we haven't seen the results of it yet in terms of impact.

COLONEL STEEL: Exactly. And it's a complete aircraft review, so it's a larger scope than the previous examples we've seen.

GENERAL DAILEY: There was one on hydraulics. Was this the same team, or are they considering everything?

COLONEL STEEL: That's a part of the same team.

GENERAL DAILEY: All right. So in other words, do what the Tiger Team says to do --

COLONEL STEEL: Yes, sir.

GENERAL DAILEY: -- is what we're saying

here.

And -- Okay. So this is a continuous improvement.

COLONEL STEEL: It's a "goods news" story.

GENERAL DAILEY: Okay.

COLONEL STEEL: Exactly.

GENERAL DAILEY: "Don't relax" is the message here.

COLONEL STEEL: Stay focused. Yes, sir.

GENERAL DAILEY: Any...

COLONEL STEEL: I'd like to bring Mr. O'Connor back up to address reliability concerns as we enter the combat effectiveness phase.

MR. O'CONNOR: As I mentioned before, reliability has tentacles that go into various areas, and the next one has to do with how the reliability affects readiness as measured in the operational evaluation.

We didn't look at activities since the operational evaluation. We took the data from -- only from OPEVAL. And the results were mixed when it comes to reliability and availability metrics. There was a Low Mean Time Between Failure that was highlighted during operational evaluation, and poor reliability, especially

in the hydraulics systems, was one of the big actors there.

There was also -- In this particular one, though, there was a late change in the requirement -- the effective requirement that was made in 1999, which caused the program to be measured at a higher standard when it comes to Mean Time Between Failure, and that's part of this story as well.

The numbers I have up here just shows you that the numbers that they look at for those four measurements, which are all availability related, only two of them passed: the Mean Flight Hours Between Abort, the Mission Readiness, both passed, but the other two -- Mean Flight Hours Between Failure and Mission Capable rate were too low.

The Mission Capable rate turns out not to be all that different from other aircraft at this stage, and I think that plays in the conclusions. But Mean Flight Hours Between Failure was a big issue with the operational testers.

The January Program Office response to these operational evaluation assessments was that they do have in work reliability improvements, especially in the

hydraulic and the actuators, to improve the reliability, to get it to the requirement value of 1.4 Mean Flight Hours Between Failure, but not until the end of 2003.

Now, the aircraft were not designed to this new change in requirements. If you look at how it was designed and take it back to that pre-1999 number, which will be closer to about 1.1, then the program should be there by the end of this year if it were to go forward. So there are two ways to look at that one.

Now, when we look at the next chart, we show this planned improvement. The dark line up there is the requirement of 1.4 Flight Hours Between Failures, and as you know in the subpanel discussions, when they talk about failures with this particular measurement, they're talking about any kind of failure. An engine failure counts the same in this particular metric as a light bulb failure, and so it's all failures.

The blue stars there show you three other aircraft that are currently in the fleet and what their current values are, and it shows that the V-22 requirement strives to be higher than the best of those aircraft -- the HH-60 -- but it's well better than H-53 or 46 as demonstrated.

The subpanel was not as interested in Mean Time Between Failure or Mean Flight Hours Between Failure as the OPEVAL tended to be and asked that the program show what this means in Mean Time Between Aborts, because that tends to be a more important measurement in some cases. It turns out they did meet that requirement. And as they go and put effort, resources, money and so on, into bringing that Mean Time Between Failures where it's supposed to be, this is the effect it has on Mean Time Between Aborts. Further improves it.

Conclusions.

The operational availability of the V-22, as demonstrated in the OPEVAL is not adequate. However, it is not clear that the Mean Time Between Failure or Mean Flight Hours Between Failure, however you measure it, is as important to the users as Mean Time Between Aborts would be, which was an adequate measurement during the test.

The plan to meet the threshold for Mean Flight Hours Between Failure includes improvements to the hydraulic system, and shows late 2003 when it should be met.

With no apparent service need change, the

Mean Time Between Failure requirement was effectively changed to a stricter standard late in development, well after the final design of the LRIP aircraft which flew that OPEVAL. In other words, too late for them to really do anything to change those aircraft to meet that new standard.

Contractor component reliability predictions during early design and development were substantially better than that demonstrated during the OPEVAL. And we talked about that one earlier.

The recommendations that would come from those conclusions, if you accepted them:

The Services should revalidate the threshold requirement for reliability consistent with relevant reliability requirements drivers. In other words, go look and see how important this Mean Time Between Failure really is before expending a lot of resources on it to fix it.

The Defense Department and the contractors should improve their reliability prediction models and processes, and review the reliability improvement plan and prioritize deficiencies to insure that funding is applied in prioritized sequence.

GENERAL DAVIS: Mr. Chairman, as you pointed out in one of the subpanel meetings where you and I were meeting to discuss this thing, the standard they applied causes you to treat a light bulb the same as a hydraulic actuator. And there again, they might dilute the process by trying to buy a better light bulb than a better hydraulic processor, and I think that's very clear -- one of the reasons why we came to the conclusion why the real standard probably ought to be Aborts, because that really tells you a better story. And that could be a great detriment to the program if they treat, you know, a light bulb the same as something that's far more important.

GENERAL DAILEY: I guess the question I have -- Have they achieved -- I see they were supposed to be above the line by now. Are they above the line in the Mean Time Between Aborts? Well, I guess they're not because they're not flying.

MR. O'CONNOR: Well, that's meant to be the January plan, which has been slipping --

GENERAL DAILEY: Okay.

MR. O'CONNOR: -- would have achieved that 1.1 area in the fourth quarter of this year.

GENERAL DAILEY: Right. Okay.

And I think that -- What we're saying is that under the Mean Time Between Failure criteria, you could have some number of items that have failed --

MR. O'CONNOR: Right.

GENERAL DAILEY: -- and still fly the mission successfully because -- But if there was such -- or if there was one failure and it was of something that required the mission to be aborted, then that measurement would be more significant in terms of actual combat capability. That's what we're saying in this --

MR. O'CONNOR: That's correct.

GENERAL DAILEY: Okay.

MR. O'CONNOR: Now, my understanding --

GENERAL DAILEY: So what we're recommending is that rather than going out and trying to fix everything based on test results, figure out which are the most important, spend the money on fixing those things that actually result in capability --

MR. O'CONNOR: That's the idea.

GENERAL DAILEY: Okay.

MR. AUGUSTINE: I guess I would like to add a gratuitous comment to the important point you both

made: that to me, one of the failings of the defense acquisition process is that requirements are specified which become very sacred and a lot of money and effort is spent trying to meet requirements that they become irrelevant. They may have been irrelevant in the first place, or they may just be wrong.

And I think this is an example of that, where we have a requirement that this doesn't distinguish time on the ground and time in the air; it doesn't distinguish light bulbs from engines. And yet, we're spending a lot of effort; we're measuring this aircraft by its ability to meet a requirement that's relatively meaningless, in my judgment.

It would seem to me a more appropriate requirement -- Really would be two. One is the one you suggest -- Really, that General Davis suggests. That is, Mean Flight Hours Between Mission Failures, and then a second one that's Mean Time to Maintain or Mean Time to Repair.

And if you have those two -- You may want other things, too, but to continue to spend a lot of money and to measure the program with this parameter is I think not fruitful.

GENERAL DAILEY: What we're saying is, measure the time that it takes for it to break and then how long does it take to fix it after it breaks. Those are the things that --

MR. O'CONNOR: Mean Time to Repair is one of those things that is measured.

GENERAL DAILEY: Okay.

MR. O'CONNOR: The aircraft, by the way, did not do very well in that measure. There's a lot of work to be done to improve maintenance all around in this aircraft.

MR. AUGUSTINE: That gets into sparing and the whole thing.

MR. O'CONNOR: That's right. And the tech pubs and so on.

Okay. Go on to the next one --

GENERAL DAILEY: Well, so do we think that this captures that?

MR. AUGUSTINE: I do.

GENERAL DAILEY: Okay. Everybody okay with this, then?

MR. AUGUSTINE: We may want to be more specific somewhere in the text of our report and say,

"Consider using such things as Mean Flight Hours Between Mission Failures and Mean Hours to Repair."

MR. O'CONNOR: Well, I think that Mission Failures is the Abort, Mean Time Between Aborts.

MR. AUGUSTINE: But I also want to get Mean Time to Repair in there somewhere.

MR. O'CONNOR: Mean Time to Repair is a measurement. I didn't include it in this issue because it was not reliability related, but that is one of the requirements and they failed it. They failed to meet that one as well for a variety of reasons that were not reliability --

MR. AUGUSTINE: We ought to throw that one out because we're done with it.

DR. COVERT: There is a section on maintenance; is that right?

MR. O'CONNOR: I have that next.

DR. COVERT: All right.

MR. O'CONNOR: Maintainability and the Nacelle.

The nacelle was by far the biggest particular feature here in this maintainability discussion as you noticed on your walk-arounds of the

actual aircraft and talking with the crew members, the ground crew members.

Several factors make maintenance and inspection of the nacelle hardware very difficult: tight quarters; poor inspection access; lack of access; and in those areas where there are access panels that are not quick access panels, the fasteners that are used for those panels are inadequate. They break easily and they get lost and they become foreign objects.

Other factors that add to the maintenance challenge with the nacelle are lack of consistent configuration from one airframe to the next, which is covered by the quality issue brief, and that is one again that this Tiger Team is just now bringing out that they see some of that.

The high failure rate of the click studs, which is that device that we looked at, that fastener, that causes a lot of problems in the tight quarters in the nacelle, but is also in other parts of the aircraft. Poor maintenance publications. This will be covered later. And normal operational issues that apply to any kind of aircraft in the field on top of all those.

Potential Conclusion for Maintainability

and the Nacelle: The tight spacing of critical hardware, lack of adequate quick access and poor reliability of the fasteners on the remaining access panels, combine to make the nacelle a maintainability challenge. The effect, at best, is high maintenance man-hours, and, at worst, missed critical failure precursors.

Recommendations.

Investigate the possibility of providing more quick access panels for the maintainers, and to evaluate high reliability alternatives to the Mini-Mark fastener, the one that fails so often.

Investigate the feasibility of a nacelle redesign to improve the spacing/protection/of critical components, maintenance working space, access and overall maintainability of this critical aircraft area.

Include in any nacelle redesign the potential for user-friendly inspection capability for components that are exceptions to the flight controls system redundancy requirements and other critical components, either with borescope access, more easy access panels, and so on.

GENERAL DAVIS: Doctor, you can help me with this. In the design of the nacelle, access panels

weren't put in there because they would lose strength in that process?

DR. COVERT: It's hard to say because access panels -- some of them actually are load-carrying and others are not. I think that it's hard to know -- I'm not a mind reader, as well as not an English major, and so I -- Usually you don't put in access panels when they start interfering with the manufacturing process. In other words, you could probably design something that was very easy to get at but would probably be heavy and harder to build. Again, it's one of these trade-offs.

I won't stick my neck out any further than that for you, sir.

MR. O'CONNOR: Sir, we found there were three types of access panels on a nacelle: one quick access that had easy opening, high reliability fasteners. The fasteners were not an issue. The second type of access panels were load-bearing panels -- load-carrying structure panels -- that had these Mini-Mark fasteners because of that.

It turned out that there is a third type, and that is, non-easy access, access panels that have these same fasteners, but they are not load-carrying

areas of the nacelle. They are candidates to go to a better fastener, and easier access, and that's what we want them to look at.

And I think that -- Well, I know the -- Well, I've been told the Tiger Team is looking at that very thing. You remember that it took them 14 man-hours to completely open all the access panels down there to show us the inside of that nacelle. That's not good maintainability.

DR. COVERT: That's 14 man-hours?

MR. O'CONNOR: Right.

GENERAL DAILEY: So this is a significant recommendation that we've got here. So this is a "take this nacelle and do whatever is necessary to reengineer it so that it fixes not only the accessibility for maintenance, but does all the other things we've talked about -- hydraulic lines, electrical bundles, ability to inspect, reach, or replace.

So this is a very big effort here, and this is probably one of the most important recommendations we're going to have here in terms of the success of the program in the future.

MR. O'CONNOR: Yes, sir, it is.

GENERAL DAILEY: Okay. So this doesn't tell them how to do it. It just says that things need to be done in these areas.

MR. O'CONNOR: Right.

GENERAL DAILEY: And these will complete the review in terms of -- So it's more than maintainability and reliability here. This is safety, performance, everything.

MR. O'CONNOR: Well, you remember in the safety discussion some of these very things came up: chafing of hydraulic lines.

GENERAL DAILEY: Right.

MR. O'CONNOR: That's happening in that same nacelle because of the tight quarters.

GENERAL DAILEY: What I'm getting to, do we need to address -- Well, I guess you've said it here: include -- That this actually impacts on almost everything else that we've reviewed in terms of -- Is that adequately stated in this recommendation?

MR. O'CONNOR: This may be one that we would suggest could be highlighted as one of those wrap-up conclusions.

GENERAL DAILEY: All right.

MR. O'CONNOR: Executive summary-type level, because it --

GENERAL DAILEY: To give it special --

MR. O'CONNOR: Because it does show up in several places in the issues.

GENERAL DAILEY: Okay. And I think that's going to be -- We need to, based on the knowledge we have now, do some of these summary-type things; so that even though people can go through and read this as individual items, at some place, based on the experience we've had so far, we need to say, "This is what counts," and "here's how it comes together."

MR. O'CONNOR: Right.

GENERAL DAILEY: Okay.

MR. O'CONNOR: Colonel Schwartz is going to pick up with the technical publications.

COLONEL SCHWARTZ: On our trip down to VMMT-204, New River, one of the areas we received the briefing on and a demonstration of was Integrated Electronic Technology Manual system that they're using down there. IETM is something that all naval aircraft are going to and it shows a lot of promise, and it has -- This slide demonstrates what it's supposed to do.

It allows the maintainers greater flexibility. All your information is on a personal electronic data display that they have, they carry out to the aircraft, although this system doesn't yet integrate with the aircraft, future systems are going to integrate with the V-22. So they can take it out, plug it in, get the data off the aircraft and read it there.

Additionally, software is updated every 45 days. Prior to this system, with publications, as you know, you'd get publication changes, but they would come at odd intervals and they may be extensive, and then you had to cut-and-paste into the publications that you may have for an aircraft. And these are voluminous. I mean, there are volumes and volumes of aircraft maintenance procedures and data that we have currently in publications. This electronic data display that the crew chiefs have -- they take it out to the aircraft -- will hold all that data.

The system is also easily transportable, and that's a key feature. Two or three aircraft on a separate deployment from the squadron could take a system with them and don't have to take copies of all the publications.

So it offers a great deal of promise.

Unfortunately, there are a lot of problems with the system as it currently exists and that we discovered while we were down there. These are some of them: incomplete data; inaccurate maintenance procedures that are in the manuals, that are in the IETM; poor organization of the data and the procedures, and a lack of clarity; poor integration of the logistics support.

Of note here: the V-22 is the only aircraft using the Universal Numbering System for its logistics support. The rest of the naval aircraft use a system called the Work Unit Code to identify parts, so this is somewhat significant.

One of the things that we -- There are two methods by which the IETM is validated. They are validated and they're verified. Validation is done by the contractor. Validation of the IETM was done prior to OPEVAL. One of the things that we discovered was that 85 percent of the validation was done either by simulator or tabletop, and only 15 percent was done on the actual aircraft. We investigated this a little bit further and discovered that in three other instances this data is comparable.

There are probably over 20,000 maintenance procedures that need to be validated, so there are quite a number of procedures. Not all of them can be validated on the aircraft. So this was not unusual, but we had a question about it when we looked back and we saw some of the problems with the item that's out there and some problems with the publications.

The Bell/Boeing verification support was contracted for and subsequently descoped to reallocate funding elsewhere on the program.

Now, that verification of the pubs is done by the government with contractor support, and that is currently scheduled for the fourth quarter of '01.

GENERAL DAILEY: Let me just interrupt you for a second.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: This is another case where we have -- You've just said that this was descoped due to lack of funding --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: -- or for the need to move funds somewhere else, and we need to keep track of these things as we go through. This is a trend that I

think is present in this program that reflects or has the indications of an underfunded program, and the --

COLONEL SCHWARTZ: Yes, sir, it does.

GENERAL DAILEY: -- types of activities that have taken place I think are showing that.

COLONEL SCHWARTZ: We'll capture that in the summary, sir.

GENERAL DAILEY: All right.

COLONEL SCHWARTZ: Possible conclusions that we reached: As currently fielded, the IETM fails to meet the needs of organizational maintenance; the hardware and supporting software is immature and developmental in nature -- and that was a major issue for us, the fact that it was developmental in nature but it was down in a squadron and the squadron maintainers were trying to work with a system that was basically developmental.

Significant development and testing needs to be accomplished before IETM is ready for Fleet introduction. Verification of IETM needs to be accomplished as soon as possible, and it is scheduled. Based on field performance to date, it appears that technical publication validation was inadequate.

DR. COVERT: Rick, will you go back, please?

COLONEL SCHWARTZ: Yes, sir.

DR. COVERT: Am I inferring correctly, that because this hardware is immature and developmental, some of the maintenance man-hours that are so high on this airplane are a consequence of using the IETMs as opposed to old-fashioned paper-type manuals.

COLONEL SCHWARTZ: That's a very good point, Doctor. When we queried the squadron, the best that they could give us was that probably they lost 15 percent of maintenance time due to these problems with the IETM and the problems that the maintainers had in trying to find documents, schematics, parts, things that they needed out of the database. So they lost relatively 15 percent.

Now, that is difficult to quantify in readiness, but obviously it does have an impact on readiness. And when we asked the folks down there, they did say that it was an impediment to readiness, squadron readiness. But it's not something that we were able to quantify.

It's hard to quantify it when a crew chief

takes two or three hours to find a part. How long should that have taken him in a paper publication?

GENERAL DAILEY: You know, under the conclusions here, would it be something -- should we even mention that this IETMs is working successfully on other airplane programs?

COLONEL SCHWARTZ: There are different electronic tech manual systems, sir. We looked at a number of different systems and some are, yes, sir. The F/A-18 has a program that seems to be working.

GENERAL DAILEY: But by definition, this IETM system is capable of working?

COLONEL SCHWARTZ: Yes, sir, it is.

GENERAL DAILEY: It's not working here.

COLONEL SCHWARTZ: Yes, sir, it is.

GENERAL DAILEY: So I'm not sure that, after reading these conclusions, you know, that it sets us up -- I would question reading this whether it's even possible to make it work, and the answer is "yes, it is," but we're going to have conditions as to how --

COLONEL SCHWARTZ: Yes, sir, we do.

First of all, the V-22 Program should expeditiously assess the options for V-22 technical

publications. This particular IETM is causing a great deal of problems. As you mentioned, General, there are other items out there that are working. The F/A-18 has a program that seems to be further along and further on track. Additionally, we looked at a number of different systems that show some promise. So we're asking the Program to go back and take a look at options with the Program.

Significant development and testing should be accomplished prior to operational deployment. We need to provide adequate developmental support to the squadron for the selected system. What we don't want is a situation where we go back to 204 and provide them with another system and not the developmental support to get it where it needs to be so that they can effectively operate.

Review the adequacy of contractor completed validation process in light of operational deficiencies and the heavy reliance on simulation. Although this seemed to be consistent with previous validations, the number of problems and significant problems that the squadron is having kind of indicate that there was a problem with that validation process.

Verification of IETM should be accomplished as soon as possible, and we need to address standardization, testing and funding requirements for Electronic Technical Manuals across all platforms and services.

As we looked at a number of different systems, we found various standards and varying success in meeting those standards, and it was kind of indicative that each aircraft program was almost on its own to go pick and develop and choose a system that worked for it.

So that is going to cause some problems, as we discussed, for Marine expeditionary units. For example, a Marine Expeditionary Unit going on deployment may have four or five different Integrated Electronic Tech Manual systems within the squadron, a composite squadron of a number of different type aircraft trying to operate out of one maintenance department, so that could be a problem.

Any questions on those recommendations, sir?

GENERAL DAILEY: When we say "accomplish as soon as possible," do we need to put something in there and say -- Is there something that should not

happen until this is accomplished? For example, should an operational squadron be commissioned before this system is up and operating?

COLONEL SCHWARTZ: What we had said was that it shouldn't be accomplished prior to operational deployment. We need to be a little stronger on that second bullet? Is that what you're saying, General?

GENERAL DAILEY: Okay. All right. Then that's good enough.

Well, wait a minute. "Significant development and testing," but how about -- "Improvement" is what we're talking about. The system needs to be upgraded; improved; made usable, or whatever -- serviceable. I'm not sure what the magnitude of this is, but they need to have a system that works before we deploy a squadron. That's kind of the message, I think.

COLONEL SCHWARTZ: We'll look at that second bullet and try to make it stronger.

GENERAL DAILEY: So, you know, significant development and testing is required, but the system needs to be operational before deployment.

COLONEL SCHWARTZ: And we can add that bullet. Yes, sir.

MR. AUGUSTINE: You can just take the words "prior to operational deployment" and put it up in front of that whole list.

GENERAL DAILEY: Yes. Okay. Yes, there you go.

MR. AUGUSTINE: Yes, it all fits.

GENERAL DAILEY: All right. Have you got that?

COLONEL SCHWARTZ: Yes, sir.

One of the briefings that we had early on was a briefing on the Optimized Naval Aviation Logistics Command Management Information System. This is the new NALCOMIS that is being used in 204. The reason we got briefed on it is because VMMT-204 was the first Marine unit to get this new Optimized NALCOMIS system. At the time VMMT-204 got this system, it was in developmental test. It has since moved on to operational test, and we'll talk a little bit about that.

A little background on the system. Optimized NALCOMIS is part of the Navy's initiative to fully automate its aviation maintenance environment. This is what it was designed to do. The Navy had a very aggressive plan to field this system.

Navy leaders identified significant drops in reported readiness accompanying the transition from NALCOMIS to Optimized NALCOMIS, and that was one of our concerns and one of the reasons why we received the brief on this -- because we were looking at the readiness numbers in 204 and trying to understand and determine what those readiness numbers actually meant, and the numbers we were receiving were a lot lower than what we had anticipated because we were expecting that they would be under the legacy NALCOMIS system. So there was a little bit of confusion about what those readiness numbers actually meant.

Line organizations are currently unable to quantify the readiness numbers relative to the CNO's established Mission Capable and Full Mission Capable readiness rates, so they were reporting under both systems: the legacy and Optimized.

Just recently, over the last week, we received a message from OPTEVFOR -- the Operational Test & Evaluation Force -- has recently recommended withdrawal of certification of the system for Follow On Test & Evaluation and to discontinue fielding because of mission failures, inadequacies, and data integration. There were

some significant problems with the system.

On our visit with 204, these are some of the problems that they experienced. Again, I think the major concern here was that they were participating in developmental test. They had a brand new aircraft, the V-22. They had brand new Integrated Electronic Tech Manual system that they were trying to use, trying to develop, and they also had a developmental program with the optimized NALCOMIS.

Within that maintenance department, there were significant challenges, and the Optimized NALCOMIS certainly contributed to the challenges that were ongoing for those maintainers.

Conclusions.

High number of deficiencies; baseline data has not been developed to properly evaluate performance of the reporting units; inclusion of NALCOMIS with draft documentation in 204 as it faced the requirement to field a new aircraft without verified maintenance publications, coupled with an immature IETM, clearly complicated the challenge for the squadron.

GENERAL DAILEY: I think we can count that as an understatement.

COLONEL SCHWARTZ: Yes, sir.

Recommendations.

NAVAIR should correct the deficiencies and incompatibilities that are resident in the NALCOMIS Optimized system as soon as practicable; they should provide a set of guidelines and metric algorithms to all organizations who use NALCOMIS readiness data for planning, budgeting and other resource decision-making. And VMMT-204 should be given careful consideration in any deliberations concerning OPTEVFOR decertification recommendation.

That is the system that they have and that they are trying or were trying to use. They're still using it. They have culled together and are working to get a legacy NALCOMIS capability back, but that capability didn't exist, and the maintainer down there in that squadron had to go get it themselves and bring it into the squadron so that they could report legacy NALCOMIS. So it's a significant challenge.

GENERAL DAILEY: So we have a squadron that's standing up a new airplane, being supported by a system that is in evaluation itself.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: And now has been recommended for decertification, so the squadron will then have no systems unless they go back to --

COLONEL SCHWARTZ: They're going to have to go back to legacy NALCOMIS, sir.

GENERAL DAILEY: Which is a system they were not using before?

COLONEL SCHWARTZ: Yes, sir. They weren't using that before.

GENERAL DAILEY: Is it similar or is it going to be --

COLONEL SCHWARTZ: It's different, sir. There are some significant differences.

GENERAL DAILEY: Okay.

COLONEL SCHWARTZ: One of the major differences is that the maintenance instruction, the 4790 that is used by legacy, is an older version. The newer version was used for Optimized NALCOMIS, but as we understand, it hasn't been published yet.

GENERAL DAILEY: Does it mean that the maintainers who were in other squadrons, so would be familiar with the previous system --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: So the training may be not as significant to get them up to speed on this?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay. So there is a fallback.

COLONEL SCHWARTZ: Yes, sir, there is.

GENERAL DAILEY: And it will require some adjustment in retraining and --

COLONEL SCHWARTZ: The Marines always have a fallback. Yes, sir.

GENERAL DAILEY: Okay. That's good.

Okay. And then coupled with the IETMs -- Were we going to talk more about the tech manuals and documents that need to be upgraded to get that to where it works?

So this is a package deal. The whole thing needs to be fixed.

COLONEL SCHWARTZ: Yes, sir, it does.

And that's the concern right now within VMMT-204 as it continues to struggle with the challenges in V-22.

GENERAL DAILEY: Is this another one that needs "before operational deployment" at the top?

COLONEL SCHWARTZ: We could probably add that up there. Yes, sir.

GENERAL DAILEY: Well, I mean, how can -- You're setting people up to fail --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: -- if we don't do it, right?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay. How could you field an operational unit under those conditions? Something has to be different. So they either have to go back to a different system that does work or fix this one, but they shouldn't do -- they shouldn't deploy until they do one or the other. I think that's kind of what we're saying.

COLONEL SCHWARTZ: Yes, sir.

MR. AUGUSTINE: We really couldn't maintain an existing system with that.

GENERAL DAILEY: Which then means that some time in the future, they'll have to re-transition to the intended system, I guess. Right?

GENERAL DAVIS: Mr. Chairman, as you know, I mean, we have a -- we're bringing on a complex aircraft

that is a bit schizoid. It thinks it's a helicopter and an airplane. We're imposing a maintenance manual system that's neither been validated or verified, and it is very difficult to find parts numbers. There are no schematics in the system. Then on top of that we're putting NALCOMIS Optimized system, which we don't have the software in the field to use it.

It seems to me like an unnecessary burden on the people that are trying to bring them on, and it could affect both their -- it will affect their combat readiness and could affect the safety. I think it's a very important point you're making.

DR. COVERT: I think, more serious, General, you're training a bunch of people on a system that's not going to be available when they stand up operational squadron. I think this is a very important recommendation and I think we ought to...

GENERAL DAILEY: So the recommendations are proper, but we need to put a time -- we need to put a stipulation, I think, that says we shouldn't deploy operationally until these things are fixed to the point where they will adequately support the squadron.

COLONEL SCHWARTZ: Yes, sir. We'll add

that to both the IETM and to NALCOMIS, sir.

GENERAL DAILEY: For both of them.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Well, actually, it's the whole support system.

COLONEL SCHWARTZ: And that's an issue we can --

GENERAL DAILEY: The update in the tech manuals -- or the completion, I guess, of those, right?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: And then the integration into the electronic display, and then the reporting system that is the overall controller, I guess.

COLONEL SCHWARTZ: And the executive summary probably should contain some of that information. Yes, sir.

GENERAL DAILEY: Do we need to make a comment also that -- maybe it's a conclusion -- that even when NALCOMIS Optimized is up and running properly, that the readiness levels that are displayed will be lower than we're used to seeing under the legacy system?

COLONEL SCHWARTZ: When we had the

briefing from --

GENERAL DAILEY: Because of the characteristics of the --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: A more complete reporting system than has been in use in the past.

COLONEL SCHWARTZ: The Navy hierarchy is supposed to get together and develop business practices for Optimized NALCOMIS that will identify and hopefully quantify what Mission Capable and Full Mission Capable rates mean under this new system.

GENERAL DAILEY: My point is that readiness and reliability have been issues with this airplane.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: And so it's going to get unusual scrutiny when it's fielded as whether that's improved. And if a system comes in that just automatically puts it at a lower level because of the content of the system, is that worth commenting on?

I mean, we don't want to create expectations that someday this thing is going to go straight up in readiness because, based upon all of the

inputs that go to this Optimized NALCOMIS, it doesn't look like it can do that.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: I mean, all the squadrons that are using NALCOMIS Optimized have all experienced a degraded --

COLONEL SCHWARTZ: Their rates are 40 to 50 percent below what they were previously. Yes, sir.

GENERAL DAILEY: Forty to 50 percent.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay. I think we need to make a comment to not create an expectation that even when all this is fixed, that it's going to -- But in the meantime, I guess this -- When you talk about established -- We need to have a database or a baseline against which to compare this that will be different from what we're used to in terms of OPREADY rates. Is that --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: That's true? Okay.

But then if the whole thing works, we will have better support of our fleet because it will include the entire inventory as part of the picture as opposed to just in-status aircraft.

COLONEL SCHWARTZ: Yes, sir. If it works, it will identify and save us a lot of money regarding logistics and logistics support, and also identify what our capabilities are real-time.

GENERAL DAILEY: But there's no constant in this program.

COLONEL SCHWARTZ: No, sir.

GENERAL DAILEY: Everything is variable because --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: -- we don't know how anything works at this point since they're all brand new.

I think we need to -- I don't know whether -- It's not a recommendation, necessarily, but certainly maybe an observation. Maybe a conclusion. We ought to include it in those, that we should not conclude that this is going to reflect readiness levels that people are used to seeing.

COLONEL SCHWARTZ: The next issue is Maintenance Training System.

In '96, the Department of the Navy invested $41 million with Bell/Boeing for the development of a Naval Aviation Maintenance Training Suite. It was

to consist of these components: composite maintenance trainers; composite maintenance procedures trainers. They were going to replicate 1335 maintenance tasks with these trainers.

Reflectone was selected as the contractor. Work stopped in '97, and a no-fault mutual rescission was signed in May of 2000. Basically, Reflectone could not meet the contract. The rescission gave us some money back, but we did lose some money.

Bell/Boeing and PMA-205, who was the Program Manager for aircraft training devices, took the remaining $14 million and agreed to buy low fidelity part task trainers that would be built, and a separate contract would be let for Integrated Multi-media Instruction, which we currently have, and high fidelity cockpit maintenance trainers.

Boeing came in with an estimate of $130 million for the CMTs, and the Program Office decided that that was too much money; so instead, they would use actual aircraft in place of the CMTs.

The current system consists of IMI, the Integrated Multi-media Instruction we talked about earlier, Part Task Trainers, and actual aircraft. The

system is expected to be in place and functional by September of this year.

Now, there are both advantages and disadvantages of using actual aircraft as maintenance trainers and we tried to capture those here. The advantages are on this page, and the disadvantages are on the next page.

You had to hire physical and functional fidelity with actual aircraft, obviously. Maintenance will certainly mirror that that you will get on fleet aircraft. Spares are in the supply system. And the hardware and software configuration can be simplified through the utilization of the ECP process. When we change the fleet aircraft, we can put that engineering change proposal on a trainer.

There are some disadvantages. We're going to have to buy additional ground support, which is going to cost additional money. We're going to have to be able to maintain that ground support equipment. And a concern was that aircraft components are not designed to withstand the multiple removal and replacement cycles required for training. So the concern was that this may cause additional costs and additional funding to be

required.

Possible Conclusions.

Until adequate maintenance training systems are in place, the loss of the Naval Aviation Maintenance Training System will have an impact on the capability of both VMMT-204 and the Fleet Replacement Enlisted Skills Training unit to accomplish their missions of training pilots and maintainers.

The three systems being procured should adequately address this deficiency if they are properly funded and supported.

The capability offered by Integrated Multi-media Instruction to train maintainers is state of the art. We spoke about that earlier.

And there are both advantages and disadvantages to the use of actual aircraft as maintenance trainers.

To be effective, aircraft maintenance trainers must be properly funded for spares and fleet modifications.

And the disadvantages of using an aircraft as a maintenance trainer outweigh these advantages and complicate the maintenance training for the other

services.

DR. COVERT: Rick?

COLONEL SCHWARTZ: Yes, sir.

DR. COVERT: I think this is another indication we should highlight for the final discussion, an indication that underfunding is present in almost every area we've looked at. And I won't say every area because we haven't come through the whole thing yet.

COLONEL SCHWARTZ: Yes, sir. We'll bring that up.

GENERAL DAVIS: And I would like to join in the doctor's remarks. You know, what has happened is we had a failed contract, and so to achieve maintenance training, which is absolutely essential to putting this airplane in the field, by having to buy additional things, placing airplanes into the maintenance training process, modifying them for full insertion and isolation, actually has cost the program additional dollars and taken away from their capability to complete the program.

COLONEL SCHWARTZ: The recommendation, please.

We have three possible recommendations. Retrofit and modification of maintenance training

aircraft, when appropriate, must occur at the same time or prior to those changes being incorporated in tactical aircraft.

Funding for training aircraft spares must be adequately budgeted.

And consider the eventual replacement of the aircraft being used as maintenance trainers with appropriate maintenance trainers.

GENERAL DAILEY: First of all, would we want to say that the changes should be incorporated in the trainers first, before they go into the other aircraft, so the people are going to be trained as maintainers before they get to the line? Are we willing to say that?

DR. COVERT: Ideally, that would be --

GENERAL DAILEY: Okay. Maybe ideally.

GENERAL DAVIS: Practically, it very seldom happens.

GENERAL DAILEY: Should be incorporated in the trainer before you put it in the airplane.

And we're saying we don't like the idea of using real airplanes as trainers, I guess. Maintenance trainers.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Or maybe a combination of the two, at least, to where we get more fidelity in some of the systems trainers that would normally be associated with maintenance training.

And the Air Force training will all take place at New River?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay. So it's a single-site problem we're talking about here.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Okay.

Okay. Any other comments on this one?

COLONEL SCHWARTZ: Okay. The next issue the V-22 Diagnostic Capability.

The Operational Requirements Document requires that the aircraft have a Data Storage System able to accommodate the downloading of maintenance data in 15 minutes or less to support maintenance debriefings and allow the rapid sorting and correlation of data points, and provide effective guidance for maintenance personnel.

The results from OPEVAL indicated that the

V-22 system demonstrated the capability to be adequate, reliable, and accurate.

Both fault detection and fault isolation performed well and exceeded the threshold and objective values. The problem, though, was with false alarms which failed to meet their values by a significant margin. That's what we're going to discuss.

MR. AUGUSTINE: Your second bullet there --

COLONEL SCHWARTZ: Yes, sir.

MR. AUGUSTINE: -- is a statement of fact in that it's what the OPEVAL results stated, but, boy, that's sure not the way I would have interpreted the status of that -- that it's adequate, reliable, and accurate. As you say in the next statement, it's loaded with false alarms. It's, in my judgment, not even useful in this current state.

So you're stating facts, so I can't object to that, but I --

COLONEL SCHWARTZ: Thank you, sir.

MR. AUGUSTINE: I register disagreement.

GENERAL DAILEY: We're quoting somebody else here.

Your chance is coming.

MR. AUGUSTINE: Okay.

COLONEL SCHWARTZ: The Program Office has a false alarm reduction plan and is working on software fixes for the Aircraft Maintenance Event Ground Station, and the application software. They are looking to develop diagnostic filters, hardware changes, and subsystem software updates that will have a lesser propensity to trigger false alarms.

So there is a program in place to burn down the false alarm rate of the aircraft.

Now, another problem with the diagnostic system is the --

GENERAL DAILEY: "Burn down" means "reduce"?

COLONEL SCHWARTZ: "Burn down" means "reduce." Yes, sir. To get that -- get the false alarm rate down to an acceptable level.

A second problem with the capability is that the ground station that's used by the maintainers reads six-figure Hex fault isolation codes. When the pilots come back from a hop, they take the brick from the aircraft, put it into the ground station, and they get a

readout.

Now, the readout is in six-figure Hex isolation codes that the folks in 204 don't have the capability to read, or they have to go to the contractors to get that data. So --

DR. COVERT: Does the AMEGS look like a brick?

COLONEL SCHWARTZ: Pretty much, sir. Yes.

DR. COVERT: I just wanted to know why you called it that.

GENERAL DAVIS: The brick is what comes out of the airplane.

COLONEL SCHWARTZ: The DOT&E report identified that the utility of the Built-In Test system was reduced by the lack of integration between AMEGS, the VSLED data of the aircraft, the IETMs and NALCOMIS. These systems ultimately are supposed to work together, but right now they're not working together and it's creating problems for the squadron.

Each stand-alone system, you have to take the data and add it to the other system. So this is a lot of work for the maintainers for a system that was designed to be integrated.

GENERAL DAILEY: Here's this Universal Numbering System again that we were just told on the previous slides that it's unique to this airplane and the rest of the world uses something else.

COLONEL SCHWARTZ: Yes, sir. That's true.

GENERAL DAILEY: I think we need to, at some place in here, express concern over that; that this airplane should not have a support system that's unique to it only. It may work now because of the attention that it's getting, but I think that that's setting itself up for a long-term problem -- or a future problem. Put it that way.

COLONEL SCHWARTZ: We can bring that recommendation out and move it into the executive summary.

GENERAL DAILEY: Whether it needs to go here or somewhere -- but we need to comment on UNS somewhere.

COLONEL SCHWARTZ: Yes, sir.

Two possible conclusions. The current plan to reduce the V-22 false alarm rate is too slow, and the AMEGS promises to be a powerful diagnostic tool for the maintainer, but the marginally integrated AMEGS,

IETMs, and NALCOMIS systems create undue workload in identifying and understanding system performance and maintenance issues.

And that's the real gist of it, sir. That's the heart of the problem -- is within the 204 maintenance department and the lives of the maintainers down there trying to utilize these systems.

GENERAL DAILEY: Well, the system doesn't work that's in place to maintain the aircraft or to use to maintain the aircraft.

COLONEL SCHWARTZ: It doesn't work adequately. No, sir.

Are we all set with those recommendations, sir?

DR. COVERT: Does "NALCOMIS," in the second paragraph, mean the existing NALCOMIS and not the Optimized NALCOMIS?

COLONEL SCHWARTZ: The Optimized is supposed to be -- One of the benefits of Optimized NALCOMIS, it's supposed to be integrated with these systems eventually. That's something that they're working towards.

GENERAL DAILEY: Well, I'm not -- Do we

really want to comment on the --

DR. COVERT: No.

GENERAL DAILEY: NAVAIR is going to decide what they're going to do here for the whole world, right?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: So this is a much bigger issue and we shouldn't -- Whatever it is that they do, we -- These are not in priority, these recommendations?

COLONEL SCHWARTZ: No, sir.

GENERAL DAILEY: Because I think that second one is -- you know, the integration -- this system needs to be integrated to where it's going to work, and as part of that, I would think the false alarm rate would probably be an outcome. I don't know. Maybe not.

And then -- But they certainly need to get some cross-reference so they can get a part numbers and things that they need.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: So maybe that's a -- the priority in which you do No. 2 might solve the other two, I guess. Right?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: Because both of those

will lead to the eventual successful operation -- or they should be part of that. If they don't work, then the thing's not going to work anyway.

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: That probably confused it with that, but it seems like they need to -- there are things that they should do first, but they really need to do No. 2 as the --

COLONEL SCHWARTZ: The integration.

GENERAL DAILEY: -- driver here; fully integrate the system.

COLONEL SCHWARTZ: We can make that --

GENERAL DAILEY: That each component has to be up and running. I mean, there are some very big deals here.

COLONEL SCHWARTZ: Yes sir. We can prioritize these when we...

GENERAL DAILEY: No, I don't think we -- But we need to make sure that the words -- They need to get each component to work, and then -- So maybe that's -- Take immediate steps leading towards full integration of up-and-operating components or something. Do you see what I'm --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: We don't want to integrate something...

COLONEL SCHWARTZ: Until we get it fixed.

GENERAL DAILEY: Yes. We've already got a kludge.

Okay. So each of the components needs to be --

COLONEL SCHWARTZ: And that's probably something for the report as we go through and write the report -- identify these components and then identify their integration into a system.

MR. AUGUSTINE: You probably need a separate bullet that just says to fix the components and then integrate them.

GENERAL DAILEY: And then fully integrate.

Is this another "prior to operational deployment" -- this comment?

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: I mean, I think it is. And that would put some sort of a timeline on how planners could decide how it needed and when it needed to be done.

An alternative -- Do we need to also say an alternative would be not to use this if they decide to go back to a different approach? But they need something because right now what they've got is almost worse than nothing. Is that an overstatement?

COLONEL SCHWARTZ: No, sir, it's not.

GENERAL DAILEY: Okay.

COLONEL SCHWARTZ: Programmatics. I'll cover the first issue before I turn it over to Mr. O'Connor.

During our visits to the factories and to the squadron, this became somewhat of a significant issue for all of us, I think, as we saw that there was a lack of communication by all officials of all organizations that impacted the awareness of some of the issues and concerns being raised by the Marines and Air Force personnel and VMMT-204.

In particular, some of the members of 204 were unaware of a lot of the fixes that were in place for the V-22. They were unaware of the issues that they had addressed were actually being taken for action and what was being done with regard to those issues.

This lack of information leads to a

decreased confidence level, rumors, and a reduction in morale in the unit that I believe we saw when we were there.

The issues of concern related by squadron personnel covered three areas: the safety, reliability and maintainability aspects of the aircraft, the maintenance system, and the enlisted maintenance training.

Now, we did see that the Program Office and Bell/Boeing are really working aggressively to resolve the issues as they've been addressed by 204. Since the discussions that we've had, contractors have been -- visits by the contractors have been completed to 204, and also, visits by 204 have been completed to Boeing and to Bell Amarillo and Fort Worth, or will be complete by the 18th.

The Osprey Support Center the Marine Corps Air Station, MCAS New River, is also actively engaged in supporting the squadron. The Osprey Support Center is a joint venture between Bell/Boeing and the government, located at MCAS New River, that supports 204.

The 204 gave the Osprey Support Center high marks for cooperation and support provided to them.

However, the concern is that the squadron is not being adequately informed of the status of relevant issues, particularly safety-related issues, in a timely manner.

A solution to this problem of inadequate communication can be addressed through the Osprey Support Center, but it would require a change in the support philosophy that includes at least these two things: a higher level of management involvement among the OSC, Bell/Boeing and NAVAIR, and a non-business-as-usual approach to technical feedback to the operators.

Now, we put "closer to the type of interface common in a test environment than in an operational environment." We believe that the support being provided would be adequate for a normal operational squadron, but there are some factors in 204 that require additional attention to be focused.

The pilots and maintainers in the squadron have been -- many of them have been involved in the program for a long time through OPEVAL; many of them were on the Multi-Service Operational Test Team (MOTT). They know a great deal about the aircraft and they're not getting the feedback that they did as the aircraft was going through DT and OPEVAL, so we believe that we need

to fix that.

GENERAL DAILEY: And we may need some more words. I don't think we've captured that thought that you -- and I think that's exactly what it is. Why is this different from other squadrons? It is because of the size of the community now and the experience level of the people who are in there. They are the ones that have done everything so far. And now that they're moved into an operational mode, they're getting different -- The system is feeding back the information it normally would but it's not at the level they're used to, and so it's created a sense of concern, I guess. Is that --

COLONEL SCHWARTZ: Yes, sir.

GENERAL DAILEY: We may need to flush that out a little bit.

COLONEL SCHWARTZ: We can add another bullet there in the discussion. Yes, sir.

GENERAL DAILEY: Okay.

COLONEL SCHWARTZ: Possible Conclusions.

Standard legacy reporting processes are properly being used, but appear to be inadequate to the expressed desires of the operators.

There is not enough communication of

engineering change activities from the engineering community to the operators, considering the state of the V-22 in its development and introduction.

The OSC appears to be an appropriate vehicle to improve the communications flow, but the management attention appears to be at too low a level and the feedback for operational problems and their solutions is too limited and too slow.

GENERAL DAILEY: Okay. Any comment on the conclusions?

COLONEL SCHWARTZ: Recommendations, please.

Possible Recommendations.

The V-22 Program, in coordination with Headquarters Marine Corps and 204, conduct a review of information flow requirements between the program, Bell/Boeing, and the customer, and develop a funded plan to increase the responsiveness to operator needs.

Attention needs to be given to meeting similar requirements for the Air Force and SOCOM during the CV-22 introduction.

V-22 Program and Bell/Boeing supplement the normal formal reporting chain to and from the Osprey

Support Center with feedback to facilitate the exchange of information to the customer.

Both the government and Bell/Boeing should increase the management visibility of the Osprey Support Center and decrease the turnaround time for relevant problem resolution status.

GENERAL DAILEY: I think those recommendations are good as long as we tell people why it's important by flushing that other conclusion out a little bit.

Everybody agree on that?

COLONEL SCHWARTZ: I'll be followed by -- Mr. O'Connor will talk about Joint Program and Systems Engineering.

MR. O'CONNOR: As you know, when we first looked at this program, one of the things that struck various members of the Panel was the relatively unusual alignment and organization of the contractor. They have a Joint Program Office that manages two major contractors, Bell and Boeing, that have a 50-50 split of work and of profit.

The obvious question that comes up with that sort of thing is, "How is systems engineering done?

How is integration between the two contractors and the government accomplished, and are there any holes there?" So that's what we looked at.

The Joint Program Office is located at Patuxent River and the Joint Program Office has the manager of the systems engineering activities. The system engineering, however, is not done in that Joint Program Office. It's done at Bell and Boeing by various different Analytic Integration Teams and Integrated Product teams.

They also have a very active Risk Management process which deserves a separate discussion, and they also told us that the corporate memory is one of the keys to continuity and making sure nothing falls between the crack when it comes to integration activities.

As far as Risk Management goes, they make use of Risk Management approach for all of their decision-making, which is a little bit unusual. You don't see that very often. The Risk Management approach is a pretty well proven approach for managing future potential problems, and what they've done is they've taken that same approach, applied it throughout, top to

bottom, to their program for today's problems as well as potential future ones and it's very well done.

The Risk Management is well-managed. It's personally led by the Program Manager. It's well-connected to the contractors and the systems engineering and system safety.

While the Risk Management program does not use quantitative analysis in analysis of risks, its qualitative analysis is pervasive at all levels of management throughout all disciplines.

We did look at Systems Engineering trade studies that were done early in this program, as they are in any program, to look at the priorities that have been put on various aspects of the design and the requirements, and we noticed the last one that was published was in 1993, during the engineering and manufacturing development phase, and it put emphasis on what the program priorities were at the time, and that is, aircraft performances -- that is, range, speed, payload, and shipboard compatibility. Further down the list in properties were the "ilities": the maintainability, the reliability, and so on.

Possible conclusions.

First, the Bell/Boeing Joint Program Office is a critical feature in the V-22 contractor organization, especially as regards program integration.

The systems engineering approach used by the V-22 government contractor team appears to be robust, well managed and staffed, in spite of what might normally be considered a non-optimal prime contractor arrangement.

An important ingredient in the V-22 Program's systems engineering effort is continuity among its key personnel.

The results of the OPEVAL are relatively consistent with the 1993 systems engineering trade study weighting properties. In other words, when you look at the OPEVAL results, the performance was very good on this aircraft. It made speed; it made range; it's very good on the ship. But it was very lacking in maintainability, reliability, availability, which in the trade study analysis were, as I told you, lower rates. So you could say the aircraft performed as designed.

The V-22 Program risk management approach appears to be robustly supported by management, unusually well-coordinated with other program activities. In spite of its minimal use of state-of-the-art quantitative risk

assessment techniques, it appears to be better coordinated and managed than risk management systems found in other major programs.

Possible Recommendations.

As the program proceeds, both NAVAIR and its contractors should ensure a high level of continuity and corporate memory in its Integrated Product and Analytic Integration Teams, and key management positions.

Constant attention must be paid by both the Navy and Bell Boeing JPO -- Joint Program Office -- to the potential for lapses in systems engineering integration disciplines as team members may occasionally try to solve problems directly between government and one of the contractors or between Bell and Boeing direct, without going through the Joint Program Office structure.

For the next phase of systems and requirements reviews, engineering changes, and deficiency fixes, should that be the case, the Program should update its old trade study priorities consistent with today's priorities where the "ilities" need a lot more attention.

The V-22 Program should continue to investigate the feasibility of introducing state-of-the-art quantitative risk analysis methods into

their system.

The Defense Service Management College -- I hope I got that right -- DSMC, the school that teaches government program managers at Fort Belvoir -- risk management course should use the V-22 Program risk management process as a benchmark example of how to incorporate risk-based decision support into everyday program management.

Any comments on the conclusions or the recommendations?

GENERAL DAILEY: Okay. So we like this, but the --

COLONEL SCHWARTZ: We didn't like the structure, sir. I think the Panel said --

GENERAL DAILEY: We were concerned. But when we took a look at it, we decided that it was working very well.

MR. O'CONNOR: This is not a single prime contractor with an integrator. It's a dual, Joint Program Office-led activity.

GENERAL DAILEY: But the key to it has been the continuity of the people who have been involved.

So we change "should" to "must" in that

first bullet? You have "must" in the next one.

MR. O'CONNOR: I'd vote for that, sir.

MR. AUGUSTINE: I vote.

MR. O'CONNOR: I don't -- I'm sorry, I don't get a vote, but I will agree with that.

MR. AUGUSTINE: I would suggest that's a good vote.

GENERAL DAILEY: Thank you for your confidence.

MR. AUGUSTINE: I think the joint venture approach, if we had it to do over again, most of us I think would recommend having a strong systems engineering capability in the Joint Program Office, which somehow they've made work without that in this case, but I think it's -- as you said, it's probably not an optimal way to run a program. But at this point in time, since it works, it's not worth changing.

MR. O'CONNOR: It's one of those areas where they -- You look at one part of it and you see risk; you see potential for failure; you see that they're mitigating it with other things like strong risk management --

MR. AUGUSTINE: And talented people.

MR. O'CONNOR: -- good management and talented people. So overall, I think it came out all right.

The next discussion will be on affordability, and Gary Gray will talk this and other programmatic issues.

MR. GRAY: The issues I will be presenting are about funding and funding adequacy, primarily.

DoD's commitment in the '96 President's Budget was increased to $52.9 billion from $6.6 billion the previous year. This was primarily to add production aircraft back, which resulted in 523 production aircraft: 425 for the Marine Corps, 50 for SOCOM, and 48 for the Navy. The FY 2001 President's Budget is at $38.1 billion. The reduction is due primarily to inflation reductions, Quadreniel Defense Review quantity reductions of 65 aircraft, and aggressive cost reduction initiatives. Even with those initiatives, and even while aircraft reductions have gone down by 65 aircraft, the unit production cost has decreased from $87.9 million to $67.4 million.

Budget Execution.

In order to award the FY 2000 contract,

two aircraft per year were deferred to the outyears. In FY 2001, a similar deferral would be expected, and that's due primarily to higher inflation, reduction in learning curve efficiencies, and increased work.

In FY 2002, procurement deferral would have to continue and some RDT&E resources would have to be reprogrammed if the program would have to be restructured.

GENERAL DAILEY: Let me interrupt you for a second, Gary. The giving up of aircraft is usually the last maneuver of a Program Office when they have no other options, which means they've taken every dollar out of the program that they possibly can before they cut an aircraft.

MR. GRAY: It's funded very tightly, sir. Yes.

GENERAL DAILEY: Do we see anything counter to that in this program?

MR. GRAY: No. No, it's funded right at the edge.

GENERAL DAILEY: So this is another evidence of a program that's been either marginally funded or underfunded, then.

MR. GRAY: Yes, sir.

Conclusions.

Sliding aircraft to the outyears, while it makes it possible to meet the near-term budget demands, the overall costs of the program does increase. Higher production rates can make that up, can lower the cost eventually. Multi-year can also help to restore some of that additional cost that was caused by the deferral.

MR. AUGUSTINE: This is one more example of the practice in our government of not including reserves for the unforeseen, whether it be time or technical problems or money or what-have-you, and the consequence is, unlike commercial programs, there's no way to add money within the next year or two except under the most extreme conditions.

And so what you do is you cut out testing; you cut out aircraft and so on in the near-term; you add them in the long-term, and so you have a long burn rate. The total cost goes up, and you're much worse off. It's not a unique criticism of this program by any means, but it certainly is a criticism of the way we do business.

MR. GRAY: Exactly. Funding Reserves is actually the next issue.

MR. AUGUSTINE: I'm sorry. I usually read ahead, but...

MR. GRAY: Possible Recommendations.

Do what we're doing: focus on the short-term demands and increase the overall costs of the program. Add money. And in either case, procure with a firm fixed-price, multiyear, and try and buy at an accelerated rate to keep your overall total costs of the program down.

Now, this requires a --

GENERAL DAVIS: My only comment, Mr. Chairman, is the first one you can see some sickness in there, and if you select the first one, rigor mortis is probably going to set in right after that because the program is on the feathered edge, if it's on the feathered edge right now. So to get this program back up to where it's a meaningful, safe, combat-capable program, our government's going to have to add dollars to it.

MR. GRAY: So your choice would be option "B"?

GENERAL DAVIS: "B," "C"," and "D."

Of course, that's up to the Congress -- "C" and "D." "B," "C," and "D" is all up to the Congress

and DoD, but -- But multiyear procurement gives you savings. And the accelerated rate is a little tougher, but you do recover costs because they go down. The price goes down and the schedule's met.

GENERAL DAILEY: Okay. If you took the first one -- "focus on short-term budget demands by reducing near-term aircraft procurement to live within the budgeted amounts," would that be an unacceptable approach -- to fund the fixes that are necessary to get the program up and running properly?

GENERAL DAVIS: No, sir.

GENERAL DAILEY: And what I'm getting around to is, that if you were to give up airplanes now -- in the near years, keep the money, apply it to fix the program, and then catch the maximum number of production aircraft with the fixes -- That's not what that's saying?

GENERAL DAVIS: I think that's what basically "B" is saying. "To minimize effect on total cost, provide sufficient resources to address all identified problems." You know, maintainability; reliability; testing.

GENERAL DAILEY: So are we saying maintaining the production schedule as planned?

GENERAL DAVIS: No, sir. I think you could go into low-rate production until the airplane got fully capable, and then take "C" and "D" right behind it -- or recommend "C" and "D" right behind it.

GENERAL DAILEY: Okay. So it really would be doing the same thing -- giving up airplanes in the near -- reducing the buying in the near years.

GENERAL DAVIS: Yes, sir.

Is that correct, Gary?

MR. GRAY: It actually is; it would reduce in the nearer term, but you would add money after that to try and get back cost to lowest possible total number at the end.

Now, "C" and "D" will also do that. "C" and "D" will recover some of those lost costs.

GENERAL DAILEY: That's a way you may be able to get some of the airplanes back, by --

MR. GRAY: Yes. Buying at a higher rate.

GENERAL DAILEY: Right.

DR. COVERT: But it seems prudent --

GENERAL DAILEY: So you're saying start with "B."

GENERAL DAVIS: Yes, sir.

DR. COVERT: -- to not build a lot of airplanes that you're going to end up having to modify and retrofit, because it seems to me that in the nearer term you want to stay at the lower rate production so you don't have a whole bunch of whitetails sitting out there.

GENERAL DAILEY: That's where I was coming from. But since this is an affordability issue, maybe starting with "B" is the way to do it, and then we address how you fix --

MR. GRAY: But near-term affordability is always the problem.

GENERAL DAILEY: Yes. It's like the budget year, right?

MR. GRAY: Yes. Dollars in the outyears are easier to get.

GENERAL DAILEY: Well, then maybe we need to re-word "A" as a source of funding to fix the problems now; that a reduction in the number of airplanes produced per year would be a way to free up that funding. But then essentially you get into "B," "C," and "D," to recover -- because all you're doing is driving up the program costs by doing that.

MR. GRAY: Yes. Total program costs.

GENERAL DAILEY: The total program costs. And the unit cost, also.

MR. GRAY: Yes.

GENERAL DAILEY: So to recover that, then -- Well, they really do go together. But we'd have to re-word that so that it was understood. This isn't just cut the airplanes and take the money and put it someplace else. This is --

MR. GRAY: It's "retain the money."

GENERAL DAILEY: -- reduce the production, take that money, apply it to the fixes that are necessary in the areas that we've identified, and then -- and some limited production rate until you get all that done, and then capture production aircraft with all the fixes in them as early as possible.

MR. GRAY: Yes, sir.

GENERAL DAILEY: Now, is that a...

MR. GRAY: We'll just go with one cleaned-up recommendation. How's that?

DR. COVERT: Yes.

MR. GRAY: Okay.

GENERAL DAILEY: Okay. But it includes the elements.

MR. GRAY: Yes.

GENERAL DAILEY: Okay.

MR. GRAY: Got it.

Next issue Funding Reserves.

V-22 lacks funding reserves and the design maturity has effectively been deferred. Complex aircraft need higher levels, and typically this program has been reduced 5 to 7 percent annually by undistributed reductions. It's just across-the-board cuts.

To pick up on Mr. Augustine's points --

GENERAL DAILEY: Another example, Andy, to put on your list of evidence.

MR. GRAY: To pick up on Mr. Augustine's points, reserves are always needed to address unknowns, and no reserves were provided. The CV-22 program, it is not fully funded. It's $97 million short. And it certainly doesn't have any reserves if it's short $97 million dollars.

Possible conclusions.

Provide funding reserves as needed; additional funding and reserves to complete CV as required, and DoD should increase production reserves for engineering change proposals.

MR. AUGUSTINE: I interpret those as generic comments that should apply to any...

GENERAL DAILEY: Okay. Go ahead,

MR. GRAY: CV-22 Block 0, Development Funding.

In 1994, the Deputy Secretary specified funding responsibilities for the program. The Navy would pay for the MV and CV development. The Air Force would pay for CV production, and Special Operations Command would pay for their unique equipment. In '97, the Undersecretary of Defense for Acquisition and Technology approved low-rate for the program and delegated future production decisions to the Navy.

As I just mentioned, the CV Block 0, Engineering and Manufacturing Development is short by -- the cap, as I said, was $560 million at first, and it is now short by $97 million. The Program Manager expects this cap to be exceeded by June of '02.

Conclusions.

The cap restricts accomplishments of the minimal essential requirements for Initial Operational Capability (IOC). If the cap is removed, someone must be identified to pay, and because the aircraft is grounded

and the spending rate has slowed, the program is vulnerable for funds migrating to other service priorities. If this occurs, funds may not be available to complete the necessary work.

Recommendations are to remove the cap, fund at the required levels, and retain funds in the program until the Secretary considers the Panel's recommendations.

GENERAL DAILEY: Okay. So we're saying that we believe that the requirements identified to be funded by that $97 million must be incorporated in the CV-22?

MR. GRAY: Yes, sir.

GENERAL DAILEY: That's what this endorsement says, right?

MR. GRAY: Yes, sir.

GENERAL DAILEY: And in order to do that, you have to remove the cap that's already on the program.

MR. GRAY: Correct.

GENERAL DAILEY: So we're saying it needs to be fixed; take the cap off; put the funds in there and do it right. That's the recommendation?

MR. GRAY: Yes, sir.

GENERAL DAILEY: In the meantime, since the program is under review, which is often a situation that brings in the vultures to take additional funds to go to other programs, don't let that happen.

MR. GRAY: Correct. That's where we are right now, sir.

GENERAL DAILEY: Okay. All right.

MR. GRAY: Next issue, Spares Adequacy.

Adequate spares have a direct relationship on readiness, and the adverse impact was demonstrated during OPEVAL. Additionally, the Program Office did not assume in a timely manner the government's responsibility for spares to support LRIP aircraft.

The lack of replacement parts for frequently failed components has resulted in delivery delays to the users and cannibalization of other aircraft from the production line to the fleet.

Over $700 million in spares in the outyears were reduced by the Navy by allowing amphibious ships to share spares. Five ships shared two sets of spares.

The Navy's independent cost estimate to support the milestone decision review that was to occur

in December indicated spares underfunded at about a $600 million level.

Navy routinely funds spares at about 85 percent of the projected requirement. They do this because of the high, unique spare levels result in excess inventory and assumed commonality between platforms, and the Navy's approach does not consider increased spares demand sometimes imposed by new technology.

As the year progresses and actual usage rates develop, the Navy can and does supplement the need. In fact, the PM was funded to a hundred percent of its projected funding level.

GENERAL DAILEY: So what we're saying here is that it's a conscious decision to not fund the hundred percent because --

MR. GRAY: Exactly.

GENERAL DAILEY: -- you don't really know what you need until you start to operate the airplane and find out what's going to fail.

MR. GRAY: Exactly.

GENERAL DAILEY: And then as that occurs, there is a process in place to react and start to fund those components that have been identified.

MR. GRAY: Yes, sir.

GENERAL DAILEY: Okay. So that's a policy --

MR. GRAY: And he's been getting a hundred percent of what he asked for based on a model.

GENERAL DAILEY: So actually, the program has been afforded a higher level than would normally be provided under the policy that's in existence at NAVAIR?

MR. GRAY: Yes, sir.

GENERAL DAILEY: Okay.

MR. GRAY: Conclusions.

GENERAL DAVIS: But if you have one- and two-year lead times on some of those parts, that kind of gets you in a square corner.

DR. COVERT: I think it's also important to note in the last sentence of the previous slide. That is, that the spare requirements are higher than predicted. So that, even if you have a hundred percent, you don't have enough.

MR. GRAY: Exactly. Actually, usage is higher than projected, and that is the bottom line. And that's the --

GENERAL DAILEY: Well, the reason why I

mentioned that is because the system thinks that it's already done more than it should have for the -- That's really what I was getting to.

MR. GRAY: Yes, sir.

GENERAL DAILEY: Okay.

MR. GRAY: Production line and fleet data indicate that the spare parts level is inadequate. That's the conclusion.

A possible recommendation is, provide the spare parts levels on the analysis to date -- actual analysis to date, and fund ECPs to improve reliability and reduce spare parts requirements. The alternative is the status quo.

MR. AUGUSTINE: That's pretty easy.

GENERAL DAVIS: Is that what the staff -- that second one -- calls a "throw-away"? I mean --

MR. GRAY: I didn't say that, sir.

GENERAL DAVIS: Okay.

GENERAL DAILEY: But this also -- this recommendation reinforces what we've already said about the Tiger Team: do what they say; take the actions that they've -- Those sorts of things. So this is a consistent approach, then, for the other --

MR. GRAY: Yes, sir.

GENERAL DAILEY: All right.

GENERAL DAVIS: Well, Mr. Chairman, I don't think we can accept "C." I'm going to cross "C" out.

GENERAL DAILEY: General Davis will get credit for that.

GENERAL DAVIS: Yes, I get foaming of the mouth.

MR. GRAY: The next issue is Aircraft Modifications.

Modifications are required for aircraft because the design evolves. Navy funding for the modifications was inadequate. Typically, it's at 2 percent at mature production, and the V-22 is significantly less than that.

To retrofit a fielded aircraft requires a separate funding line and funding to be identified, and that has not been done, and CV needs to address the similar problems in the future.

It is important that the ECPs be incorporated as soon as possible, and the field retrofits must be funded, and the current resource realities limit

the ECPs and retrofits that can be accomplished in any given year.

Possible Recommendations.

Maintain Low-Rate Initial Production until both the aircraft design and manufacturing processes stabilize.

Increase the ECP resources at a higher level from program savings resulting from the reduced aircraft, and establish an APN-5 funding line and fund retrofit of fielded aircraft.

GENERAL DAILEY: This is a concern here because APN-5 is a common funding line for all aircraft. It's a --

MR. GRAY: Actually, the line --

GENERAL DAILEY: It's a budget line, anyway.

MR. GRAY: That has not been established yet for V-22.

GENERAL DAILEY: Right. And there is none for this airplane.

MR. GRAY: Correct.

GENERAL DAILEY: And we know that we're going to have at least -- Even if we get an ECP that does

all the fixes that are necessary and we catch all the production aircraft with it, there still would be 30 or so airplanes that need to be retrofitted with whatever that change is.

MR. GRAY: Yes, sir.

GENERAL DAILEY: And, therefore, we think that they should start putting a funding wedge now in the MOD line.

MR. GRAY: Yes, sir. Establish the line and put money behind it.

GENERAL DAILEY: So that when the fixes are identified, they can be incorporated into the existing aircraft.

MR. GRAY: Yes, sir.

GENERAL DAILEY: Everybody fine with that?

MR. GRAY: I'll be followed by Colonel Steel, who will talk about Analyses of Alternatives.

COLONEL STEEL: Analysis of Alternatives, sir.

Both services currently have dated aircraft doing the mission. The problems with that include degraded performance and high reliability/maintainability costs. Additionally, both

aircraft are out of production, and for SOCOM, their growth is limited in the ability to address future threats.

Over the last 20 years, there have been numerous studies, Analyses of Alternatives, on the aircraft, and the V-22 has shown tremendous capabilities over helicopters, albeit more costly. PA&E is currently conducting an assessment and the results are due out at the end of this month.

GENERAL DAILEY: I notice you said "tremendous capabilities" -- you substituted that for "distinct advantages."

COLONEL STEEL: Yes, sir. "Distinct advantages."

GENERAL DAILEY: All right.

COLONEL STEEL: Again, sir, the aircraft are aging and out of production. Replacements are required, and in SOCOM's case, the infrastructure has already been traded off -- some of the infrastructure has already been traded off in anticipation of the V-22 coming on board.

Possible Conclusions is that, although there are a number of aircraft that could carry out

lesser missions, the V-22 offers the greatest capabilities with the potential to minimize casualties.

The SOCOM national mission is of such importance that we need them to be successful with their first efforts. And finally, going to a new initiative now would introduce new unknowns and challenges and force us to identify work-arounds to extend the existing programs.

MR. AUGUSTINE: Is what they're saying is that a paper aircraft is not a good replacement for a piece of hardware?

COLONEL STEEL: Exactly, sir.

GENERAL DAILEY: Okay. You didn't mention that if the operational need is legitimate, then the V-22 is the only one that can do it. Is that --

COLONEL STEEL: Correct.

GENERAL DAILEY: Okay. And so it's a validation of the requirement --

COLONEL STEEL: Yes, sir.

GENERAL DAILEY: -- which we have had done for us, but we're recommending that this be re-validated, then, by the --

COLONEL STEEL: Correct.

GENERAL DAILEY: -- services?

Okay.

COLONEL STEEL: That it be re-validated and restructured, if required.

GENERAL DAILEY: In our studies, we have been -- it's been validated to us by both the Marine Corps and SOCOM, but what we're saying is that as part of the decision process, people need to go back; and that if it's valid and everybody accepts it, then the requirement could only be met by the V-22 as we know it.

COLONEL STEEL: Yes, sir.

GENERAL DAILEY: Okay.

COLONEL STEEL: Mr. Chairman, this concludes the staff presentations to the Panel.

GENERAL DAILEY: Okay. Well, I think that it would be useful now to summarize where we are in terms of -- We've gone through the issues; we've identified the conclusions and recommendations that we're going to go forward with to the Secretary of Defense, and in a summary mode, it might -- I'd like to just open the discussion.

But since this Panel was formed primarily based on the safety issues -- it was a result of mishaps

that drove it to -- for us to be chartered -- I'd like to just get everyone's thoughts in terms of whether we have adequately addressed the issues in terms of what we've done here this morning, and then any other comments that people would like to make.

But perhaps I could just start it by saying, are we satisfied that there's no inherent safety flaw in the design concept of the tiltrotor, which is what we've said here this morning with the issue paper that we have? I think that's a major issue in terms of our outcome and I just want to make sure that we're all in sync.

DR. COVERT: Yes, sir. I would support that completely. And I'd also add that because you can tilt the nacelles, the operator has an additional degree of freedom which, when the system is mature, probably will be safety-enhancing.

GENERAL DAVIS: I'd go out and fly it today, sir. I may not do any basic fighter maneuvers with it until we've tested that regime, but clearly to go from here to someplace else and make an appropriate landing would be -- There's nothing -- The airplane is inherently -- It flies well. We couldn't find any safety

flaws that says it would not fly. There are some areas that need to be reviewed, however, before we get back to full operation.

GENERAL DAILEY: No flaws in the design.

GENERAL DAVIS: Yes, sir.

GENERAL DAILEY: But in fact, in the systems and some of the things we've -- there are things -- Okay.

MR. AUGUSTINE: You said what I was going to say.

GENERAL DAILEY: Oh, I'm sorry.

MR. AUGUSTINE: I think the way I would state it would be that we have found nothing fundamental to the tiltrotor concept that violates the laws of physics. The crashes we've seen have generally not been anything that was unique to this aircraft, but the implementation of the laws of physics in this case leave a good deal to be desired yet.

GENERAL DAILEY: Any other comments on the design concept?

How about the --

DR. COVERT: Well, I guess I'd go back to my earlier point. It is a new and different airplane.

It has an attractive blend of both the helicopter and an airplane and it should be regarded as a new machine, not just an extension of one or the other.

GENERAL DAILEY: Well, then that probably leads into -- What about the adequacy of the aircrew training? Did we see anything that -- I mean, we have specific recommendations in regard to the manuals and the simulators and the way it's being conducted, but that was generally one of the areas that it looked like we know what we're doing and -- But it just requires -- The program has learned some things as a result of mishaps that reflect on both testing and training, perhaps; and as the professor has mentioned, it's an airplane that we don't know everything we need to know about probably at this point, and so special attention needs to be placed in this area.

Would that be a fair statement in that regard?

DR. COVERT: I agree.

GENERAL DAVIS: A complex airplane? Yes, sir, it is a complex airplane, but we've brought other complex airplanes on.

But it really has two -- You know, if you

happen to be a helicopter pilot, it has another aspect to it; if you happen to be a fixed-wing pilot, it has an aspect to that. And we need to look very closely at the training process. We've been all through the training syllabi and we think everything's adequately covered, but I really think that we need to go back and do a couple things.

One, we need to raise a VRS awareness, and that can be done in a similar -- I think very easily. We ought to provide the individual a capability when he starts to approach a VRS regime that he gets a reminder, regardless of whether he's in a non-stress or a fully-stressed situation.

So I think we could probably beef the pilot training in that area, but, frankly, it's a pretty good syllabus as it stands.

GENERAL DAILEY: Okay. Are you satisfied with the recommendations that we --

GENERAL DAVIS: Yes, sir.

GENERAL DAILEY: -- brought forth with --

GENERAL DAVIS: Yes, sir.

GENERAL DAILEY: -- the VRS; that this concern will be addressed there?

GENERAL DAVIS: Yes, sir.

GENERAL DAILEY: Okay.

DR. COVERT: General Davis, how would you feel about buying one or two 609s and starting a specific training with that airplane as well as the V-22?

GENERAL DAVIS: That certainly would assist in --

GENERAL DAILEY: Well, let's clarify what we're talking about here.

GENERAL DAVIS: It's a --

GENERAL DAILEY: The potential for a smaller version of a tiltrotor as a trainer so that the flight students would be started from the very beginning in the tiltrotor environment. That's really what --

GENERAL DAVIS: Yes, sir. It's sort of a primary training phase for the process.

Again, Doctor, I think the biggest problem would be money. Frankly, that would give you an opportunity to become familiar with the two modes of flying. It may not be necessary if we put together an airplane that gives you all the cues that you need and beef up the pilot training program.

DR. COVERT: Thank you.

GENERAL DAILEY: How about system reliability? Have we adequately covered the issues here in terms of the things that -- We have covered every issue that we have had identified to us at this point. Are there any further cautions or anything that we need to -- Of course, we could always say that we need to continue to be alert for reliability or system problems.

But do we think that we've got a good list here of -- and actually a comprehensive list, I guess, is what we're looking for -- of how to proceed from here on the program?

DR. COVERT: Well, I think you mentioned earlier, sir, that the first thing is to, I think, decide if there's merit to continuing the program or merit to not continuing it, and then these other things follow should we decide that the merit lies in continuing the program.

GENERAL DAILEY: Okay. And, of course, all of our discussion this morning has been based on that assumption: If you were going to continue, then these are the things you need to do to bring it back up.

The quality program we discussed and thought that that was a good idea or a good program in

place, and as part of the risk assessment portion of that, we even thought that it was a best practice. Is that still an adequate -- even though there are issues that will always be there, but that the quality program that's in place is --

GENERAL DAVIS: Yes, sir. Is a very good --

GENERAL DAILEY: -- properly structured, staffed, and --

GENERAL DAVIS: And operating.

DR. COVERT: That's true.

GENERAL DAILEY: Okay. And one of the things that we focused on here today are the things that have been identified that are wrong with the airplane, so we've had kind of a negative focus in terms of the way we've approached it.

With Andy's presentation there on the requirements, the combat effectiveness of the airplane has been validated to us through both the users or the customers, and also the testers, and we have said that it's the only airplane that will perform the stated requirement and that the -- Well, but then it'll do it because it has the operational capability.

But then is it maintainable and fieldable at this point in terms of ready for operations? And I think we've decided that it's not -- is not until certain things are done, and we specifically identified those as we went through when we put that "do not operationally deploy until these things are accomplished."

Is that --

GENERAL DAVIS: Yes, sir.

GENERAL DAILEY: Have we done that in an adequate manner?

And then maintenance training is part of that, too. So it's the whole fielding of the tech pubs, the support equipment that goes with the integrated electronic tech manual, so to speak.

And then the training of the maintenance personnel has some bright spots. The integrated maintenance instruction we have decided is as good as we've seen. State of the art in terms of for both the maintenance of -- as we decided for the aircrew.

And then the reliability and maintainability. How about the adequacy of that? I think we've decided that there are significant issues there, but have we adequately addressed them and come up

with appropriate recommendations in that regard?

Any comments on those?

MR. AUGUSTINE: Yes. I would just make a general observation that in defense programs one typically talks about cost schedule and performance, and performance has, over the years, tended to become "does it do what it's supposed to do when it's working," and that's probably the wrong definition of "performance." "Performance" should include, "Is it going to be available? Will it perform reliably?"

And so I think it's very important that we distinguish between performance in terms of "higher, faster and better," and performance in terms of "will it be there when you need it?" It's the point you made, but it's kind of philosophical background for that.

GENERAL DAILEY: Okay. Any other comments on that?

GENERAL DAVIS: Well, I think that putting the IETMs and all of the -- the Optimized NALCOMIS and so forth into a new airplane with this degree of complexity all at the same time certainly leads to a much less favorable picture of the airplane's operational characteristics -- maintainable characteristics than it

probably deserves; but having said that, at the end of the day, it still needs a lot of help.

GENERAL DAILEY: Well, I think -- And that kind of leads us into the "programmatic" aspect of it. As we mentioned throughout, we've seen indicators of underfunding or marginal funding in areas that could continue this situation if the airplane's fielded. Its reputation could be impacted if it's not fielded in a supportable manner to where it can get off to a good start.

I think that we need to make a specific comment within the report as to the concerns we have about previous funding levels and continued -- and then actions required to get the fixes and -- because everything we've talked about here gets back to the budget.

It's a case of -- And we know that normally there is no more money. And one of the discussions we had was the way the program could offset this somewhat by reducing the production run; keeping it in limited production now until the fixes can be funded and designed so that they can be incorporated as the production rates increase.

So I --

GENERAL DAVIS: Which in turn saves you money.

GENERAL DAILEY: It does.

GENERAL DAVIS: This program is very similar to other programs. I mean, it's hard to predict the spare requirements when you have engineering data on a model that's not sure of the engineering data, so you obviously make some mistakes. There was no effort, it appeared, to overfund the spares here, which is one of the ways you can keep it going.

Secondarily, there are unintended consequences. I mean, in other words, you have some problems that have to be fixed. And there was no management reserves placed in there as other programs generally have.

And then we see a continuing degradation of the funding process within the Department of Defense. So that, plus -- as the doctor mentioned -- IETMs, have placed undue burdens on this program as far as I'm concerned.

And now they're starting to develop the fixes. Well, the worst thing in the world is to

underfund those, too, because all we're going to do is prolong the fixes. It costs more money to retrofit production aircraft some time down the road.

So if the Department of Defense decides to press this program, the best way to do it would be to stay in low rate until such -- and use the money to plow it back in to fix the airplane so we optimize it in every way: safety, maintainability, reliability, et cetera.

GENERAL DAILEY: I think one of the things that has also been highlighted and would apply to this part of the summary is that in many cases the system is working properly for this airplane. The things that are -- The communications, for example. The things that we investigated, we found that everything was normal.

But what this airplane requires is something maybe --

GENERAL DAVIS: Abnormal.

GENERAL DAILEY: -- extraordinary at this point. Not "abnormal." Better, more of at this point -- to get it up and to get the fixes in, because eventually it's going to be subjected back into the system, which then gives it its fair share of cuts and all those other things that happen and it needs to be put in a protected

mode.

Or maybe I'm saying this, but I'm looking for some agreement -- that in order to get these fixes properly incorporated, it does need to be protected in some way financially to get through this process. Is that a --

GENERAL DAVIS: Agreed.

GENERAL DAILEY: Does anyone disagree with that? I mean, it's a nice thing to say. You'd say it about any program, of course, but in this case, I really believe that it's essential.

Any other comments that anybody wants to bring up in summary as far as -- that we need to further address?

I think we can move on to the slide that everybody's been waiting for, then.

How to proceed from here. We have three alternatives that are presented. One is to cancel the program and then go with the best alternative, which we just had discussed in terms of it would mean a sacrifice of being able to perform the mission as stated and would have other considerations in terms of the cost of whatever an alternative is, and we have discussed some of

that in fair detail.

The other would be to proceed with the program as it's going right now, with no changes or in baseline, and then a third: to proceed with a restructured program, and use a phased approach to return to flight and tactical introduction with the specific recommendations, and then go to the minimum sustainable production rate in the near-term, which we've discussed.

But it's essential that that money be retained in the program so as to fund then the fixes to the developing of the engineering change proposals that have to be incorporated in the airplane to meet the recommendations that we made earlier, and then to provide adequate and stable funding for this program so that they can get it up and running.

And with that would be perhaps firm fixed-price, multi-year contracting to reduce the cost so as to be able to re-introduce some of these airplanes that have been given up to meet then the inventory requirements that have been identified.

The "requirements validation" refers to the things that we said: the services may need to go back and take a look at some of the things that the airplane

won't do right now -- and an example of that would be the fast roping out of the cabin door -- and decide how much it's worth to make that happen, because it's been determined right now that it's not practical and it was dropped from that standpoint.

But if we want to make it practical, how do you do it? There are ways. For example, the doors that come on the back of a C-141 before you parachute out the back door. There are things you can do, but are they worth it? And that's what I think we mean by the "requirements validation" there.

And then the safety -- hardware, software, and operations -- considerations that we've identified in detail in each of the issues.

Reliability and maintainability, which we also have specific recommendations on, while maintaining the quality, which we think the program is in place; maintaining the training and improving it through the documentation that would go with it, but the devices that are in place appear to be as good as you can get at this point. Technology publications are a significant part and they go with that reliability and maintainability.

And then keep everybody informed across

the program as to where we are and how we're getting there because we're into a morale-building mode at this point again with the folks who have been involved in this program, and really the confidence of the country is involved here in terms of whether this airplane is the right one to be putting our troops in to send them off into harm's way.

So we as a Panel have been charged with coming up with a recommendation to the Secretary of Defense and we need -- I think it falls in one of these three categories or a combination of them. So...

GENERAL DAVIS: The second category will probably lead to the first category. If we continue business as usual, the program is just going to get further behind. So, you know, it's almost a choice of one versus one.

MR. AUGUSTINE: Well, I'll start out if you want to go in alphabetical order.

GENERAL DAILEY: According to height, I guess.

MR. AUGUSTINE: According to height.

As you've said, we've talked a lot about what to do if you do go ahead, but we haven't really

addressed a key question, which is, should you go ahead or not?

And I must say that I view this on all our parts as a very serious obligation in the sense that we're going to ask Marines and Airmen to stake their lives on flying in this machine if we go ahead; and if we don't go ahead, we're also going to put Marines and Airmen in a position of carrying out challenging and dangerous missions with possibly not as good a machine as they otherwise could have. So it's a difficult decision.

I think by any standard I would describe this as a troubled program. Four crashes, 23 lives lost. That's a troubled program. On the other hand, we've seen that a lot of other aircraft have had very comparable loss rates or even worse at this point in time, but that's not much consolation to the people who have lost people who were aboard the airplane, the family members.

I think one sort of has to start at the beginning and ask if the mission is a legitimate mission, and here speaking as a civilian, I don't put an awful lot of weight in the fact that there is a requirement on the books or a spec to do this or that.

I'd like to put that aside and just kind

of address it from a judgment standpoint. And having talked to a lot of people who are involved, as we all have, it seems likely that in the world we live in, the Marines are going to be asked more and more to carry out the kind of mission that this airplane is designed for.

Similarly for the Air Force Special Operations folks. I'm struck by the fact that their missions almost all tend to be front-page, national prestige, on-line, have-to-succeed kinds of missions where one wants to be very, very sure before you get into them that the result will be what it was intended to be.

So I came away feeling that the mission description was legitimate. I don't want to defend a paragraph or jargon or a requirement here or there or whatever, but the mission to me made sense.

That raises a question of what are the alternatives to carry out the mission? We've talked about that. One is to take a current helicopter, a derivative of a current helicopter. That has some problems. One is that none of them offer the performance in terms of speed, range, and so on. Another is that they are either not in production or they fall short of that capability, or both. So current or derivative

aircraft certainly have some shortcomings.

One could go to an all-new development, which has traditionally been something that's been done under this kind of a circumstance. I'm not aware of any technology, nor have we heard of any, I believe, that would suggest that there is something out there that would be a lot better than the V-22 that offers a great deal more capability. The state of the art just hasn't changed that much. And furthermore, when you do that, you do usually just trade problems you don't yet know for problems you already know.

The third is the V-22, which we've already said is a troubled program -- or I've said.

And so you've got three choices, none of which are ideal. That brings you to the status of the V-22 program, which I guess I'd summarize as that it's certainly not reliable enough in its present configuration to be used operationally, in my opinion. It's certainly not maintainable in its present configuration adequately -- or adequately maintainable for operational use. All of this raises safety questions as we've seen and talked about. It does meet most of the performance or the classical performance requirements

quite well.

The key question -- and you raised it, General Dailey -- when I started out on this trip we've been on, was: Is there something fundamental in the V-22, the tiltrotor design -- something unique to it that makes it not workable? And we really haven't found that. The accidents we've found, they've been the kind of -- cotter key in the XV-15; reversed wiring on the V-22; flying out of an envelope -- out of the flight envelope. So I can't say that I've seen anything that suggests there's some fundamental physics that makes this idea a bad idea.

At the same time, it's a complex machine, both aerodynamically and mechanically, and given that, it can be rather unforgiving. And certainly some of the accidents have had as related situations the fact that it is a tiltrotor. For example, it has a tendency to roll in a VRS state.

Where do you go from here? To me, starting anew is not the answer. I think the greatest waste of money in the DoD in history has probably been starting programs, spending a lot of money on them and stopping them and not getting anything out in the field that's useful, and then starting on a new program.

Modifying existing aircraft doesn't seem to be the answer for the reasons I've talked about.

One really does come into a judgment decision. And I've talked to a lot of people that I respect a great deal, who have very different opinions on this program, but where I would come out would be that the V-22 probably is the best answer available. And it's not ready today, though, for operational use; not close to it, in my opinion.

The things that need to be done are to suspend all night operations; to suspend carrying passengers on board the aircraft; to get back into the engineering mode and a test mode; to go through and do a thorough single-point failure analysis -- particularly the flight control system; particularly the hydraulic system -- to make the engineering changes that one has to make, and then begin doing engineering tests.

And I say engineering tests here. By that, I mean the old-fashioned kind where you go out and you try to learn and you try to improve. Not where you're trying to fill out a square on a report card so the program doesn't get canceled tomorrow, but go out and test, test, test, test.

And in the meantime, I think it would be appropriate to cut the production back to the bare minimum -- and I mean bare. And the only reason I wouldn't stop production is that it's so disruptive that that in itself probably introduces more safety and reliability problems than continuing at a low rate. There's also a major cost issue that's obviously involved there.

When that's successful -- that program -- that maturity phase -- then I think is the time, and only then, to bring it back into production at a higher rate and head it towards an operational capability. And I would take however long that takes. I have no idea how long it would be, but I wouldn't let time be the driver.

I guess one maybe last comment would be that the management structure -- I'm struck by the Joint Program Office has worked much better than I would have thought. But I think for a program of this importance, if we were to go ahead, I would certainly recommend that a process be implemented where once a month the CEO of Boeing and the CEO of Bell, program manager for the government, and the Joint Program Office, spend a day or a half-a-day where those very senior people can get more

personally involved in this program, because I think it's going to take that kind of attention to pull it off.

My bottom line would be to continue to pursue the V-22, but to do it in a very deliberate manner.

GENERAL DAILEY: Does the third option there capture --

MR. AUGUSTINE: It does.

GENERAL DAILEY: -- the deliberate approach?

Okay. Professor, any thoughts on this one?

DR. COVERT: Mr. Augustine is a tough act to follow. That's my first thought.

No, I think by and large he's presented a very thorough and detailed analysis of the pros and cons, and I think that it's hard to find fault with anything that he said.

But I believe that with the suggestions -- incorporating the suggestions that he outlined, I think that the result will be a very useful and productive airplane. And it may ultimately by that point, also -- since I am an optimist and an idealist -- may also show

some other features that would have some long-term value to our economy.

So that I would -- Norm's analysis -- I would support going ahead with the program.

GENERAL DAILEY: General Davis.

GENERAL DAVIS: Sir, I vote for option three. The mission is valid, the airplane can do it, but we must be very careful how we get back to operational flying once again. I agree with both the good doctor's and Mr. Augustine's comments.

GENERAL DAILEY: Okay. I might just make a comment that when I came into this Panel, I had some reservations, being a former Marine and having been involved in the program. And so when I was asked to participate, I went to the Commandant and told him that if we do this and it comes out that the program should be canceled, that that will be our recommendation. And General Jones, without hesitation, told me, "That's exactly what I want to know."

Having gone through the process and seen what is in place and what can be done, I have the same feelings as the rest -- as has been expressed here by the rest of the Panel -- that this airplane can do the job

and can be made to work -- but I'm actually impressed by the accomplishments that the people who are operating it today have achieved under the circumstances that they've been operating. We have given them about as difficult a task as they could get.

So I believe very firmly that option three is the right way to go, but with all of the cautions that have been expressed that we have to do it right.

And I have seen in the past where panels of this type have made recommendations and there's a big surge and things start to happen and they all are going in the right direction, and then the system takes over again and the airplane settles back into the normal mode where it's subjected to the things that happen because there's not enough money; there's not enough priority; there's not enough whatever.

And I think that in this case we -- because of the things that have been stated about the complexity, the new things that we're doing here, that this one requires special attention and protection in terms of getting through and up and running to where it's a stabilized system.

So I also support this and that,

therefore, will be our recommendation to the Secretary of Defense -- that we proceed with a restructured program, with a phased approach to return to flight and tactical introduction, and specifically with the following recommendations, as amplified by our discussions here today with the conclusions and recommendations and cautions that we've identified.

Does that sound about right for --

GENERAL DAVIS: Agreed.

GENERAL DAILEY: All right. Are there any other comments or anything we need from the Panel?

DR. COVERT: Well, I think it appropriate, although you've implied it, to thank everybody that cooperated with us to the extent that -- because of the unbelievable -- Squadrons bent over backwards. Both companies, NAVAIR -- everyone -- the Program Office -- has indeed been extraordinarily helpful. I think we ought to acknowledge that.

GENERAL DAILEY: Well, that's well said. It is true that everyone who has -- We thank everyone who has provided input to us. We've listened carefully to what you said. We appreciate your concerns.

And I think that this has been one of the

finest experiences I've ever had in terms of the desire on the part of everyone, no matter which side of the line they were on -- whether contractor, government, family members, whatever it might have been -- all had the same goal, and that's to make sure we get the best possible equipment fielded that can be done. And that goal, I believe, can be achieved, but it's not going to be easy, even with the information that's in place.

And I'd also like to publicly thank the Panel. This is one of the finest, as I said, experiences that I have had. The members and the staff of -- This has not been a picnic in terms of getting through the -- Mr. Augustine has mentioned to me this is the last panel he's going to be on that's chaired by a former Marine.

But thank you very much.

And with that, this session is concluded.

LIEUTENANT COLONEL LAPAN: Two last admin announcements, please. As General Dailey talked about at the beginning, the Panel will provide its report to the Secretary of Defense on the 24th of April. That report will then be made public on the 30th of April, so the Panel members will not be entertaining any questions this afternoon.

Copies of the briefing slides that you saw here are in the back corner of the room. We ask that everyone take just a single copy for yourself or your organization, please, so that we have enough for everyone to have their own copy.

Thank you.

(Whereupon, at 1:02 p.m., the hearing in the above-entitled matter was concluded.)

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